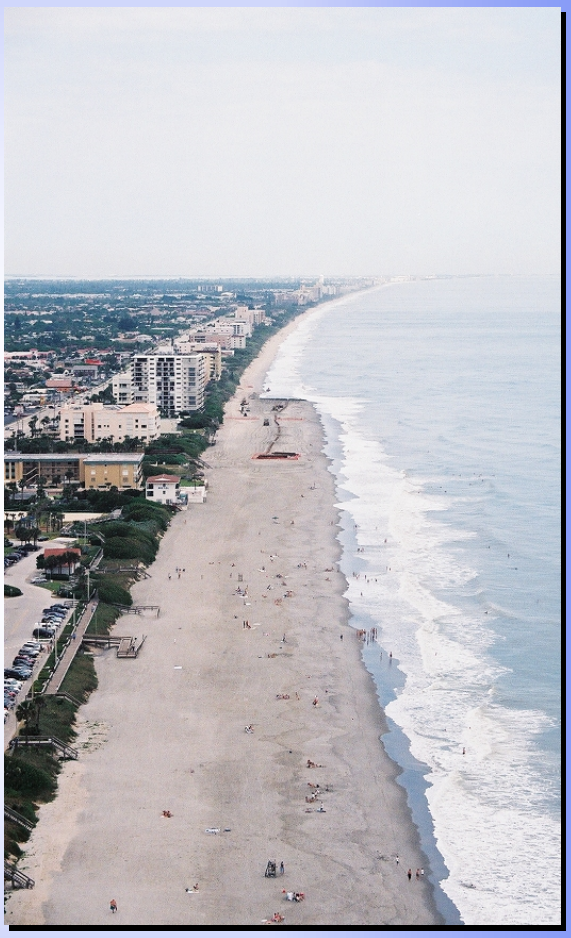
FDEP PERMIT NO. 0137212-008-JC

BREVARD COUNTY, FLORIDA
FEDERAL SHORE PROTECTION PROJECT
SOUTH REACH BEACH FILL:

POST-CONSTRUCTION
PHYSICAL MONITORING REPORT



Prepared For:
Brevard County Natural Resources Management Office,
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December, 2003

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EXECUTIVE SUMMARY

Initial construction of the Brevard County, FL Federal Shore Protection Project, South Reach (a/k/a Phase Two) involved the placement of approximately 1.6 million cubic yards (Mcy) of beach nourishment sand along approximately 3.8 miles of the Brevard County Atlantic Ocean shoreline between Florida Department of Environmental Protection (FDEP) Monument R-118.3 and R-139. The project was constructed in two segments to comply with permit conditions that restrict beach fill placement during marine turtle nesting season. Segment I (R-122.5 to R-139) was constructed from February 2002 through April 2002. Segment II (R-118.3 to R-123.5) was constructed in March/April 2003. The pay (template) volume was 1,504,005 cy.

On average, the initial project construction resulted in a 110-ft wide construction berm and a 120-ft advance of the mean high water line (MHWL). The recreational beach area was increased from 31.1 acres to 83.7 acres. This represents an increase of about 52.6 acres or 269.1 percent.

The total placed volume (R-118.3 to R-139) was 1,462,400 cy above -16 ft-NGVD, based upon the Segment I and II pre- to post-construction profile surveys. Of this quantity, 602,900 cy were placed above MHW. The contractor's total estimated placement was 1,514,081 cy.

Two offshore sand sources were used for beach fill construction: Space Coast Shoals II (SCS-II) and Canaveral Shoals II (CS-II). Almost all of the sand for the first segment of construction was dredged from the SCS-II site, with a relatively small volume (40,000 – 50,000 cy) dredged from CS-II. For the second segment of construction all of the sand was dredged from CS-II. The South Reach Nearshore Disposal and Sand Rehandling Area (SNDSRA) was used as a temporary staging area for fill material before direct placement onto the South Reach Project Area. The SNDSRA was only used during construction of Segment I. Direct hopper dredge pump-out from CS-II was used for construction of Segment II.

The beach fill was placed hydraulically in the form of a 90 to 125 ft construction berm. The berm was constructed at +10 ft-MLW (+8.1 ft-NGVD) from R-125.0 to R-134.9. From R-123.5 to R-125.0 and R-134.9 to R-139.0 the berm elevation was 10.8 ft-MLW (+8.9 ft-NGVD). During Segment II construction, the berm was constructed at a mild seaward slope from +11.5 ft to +10 ft-MLW (+9.6 to +8.1 ft-NGVD) from R-118.3 to approximately R-125. Seaward of the berm, the constructed beach slope was 1:15 along the entire project shoreline. A small dune feature was also constructed.

Pre- and post-construction surveys of the SNDSRA indicate that approximately 200,000 to 252,000 cubic yards remain in the rehandling area as the requisite 2-ft buffer placed atop the ambient seabed. Bathymetric surveys likewise indicate that approximately 1.45 Mcy were dredged from the Space Coast Shoals II offshore borrow site and there is no remaining borrow material in the permitted limits of that site.

Surveys indicate a net change (loss) of about -0.43 Mcy from the Canaveral Shoals II borrow area in the vicinity of South Reach dredging activity. Since dredging of CS-II commenced in October 2000, it is estimated that approximately 5.20 Mcy have been borrowed from the site. The net measured volume change within the limits of CS-II, from October 2000 to April 2003 is approximately -4.95 Mcy, suggesting background gains of about 0.25 Mcy relative to the estimated dredge quantity. To date, no sand has been dredged from the Canaveral Shoals I offshore borrow area.

Approximately one-year elapsed between completion of Segment I and construction of Segment II. During this one-year interlude in construction the filled Segment I shoreline (R-122.5 to R-139) exhibited an overall net loss of -55,000 cy above -16 ft-NGVD, of which -44,600 cy was above MHW. The beach south of the Segment I fill area (R-139 to R-143) exhibited net gains of +11,000 cy above -16 ft-NGVD and +25,900 cy above MHW; and, the beach north of the Segment I fill area (R-118 to R-122.5) exhibited net gains of +36,500 cy above -16 ft-NGVD and +24,700 above MHW. The gains along the adjacent shoreline are mainly the result of a feeder effect from the fill area. The net overall beach volume changes along the surveyed shoreline (R-118 to R-143), during the approximate one-year interval between Segment I and II construction, was a net loss of -7,500 cy above -16 ft-NGVD and a net gain of +6,000 cy above MHW. These represent almost negligible net change (<1 % of placed volume).

As of May 2003, along the full fill shoreline (R-120 to R-138), the berm and MHWL are on average 48.9 ft and 33.8 ft, respectively seaward of the Corps' baseline (authorized design). Along the Segment I full fill (R-125 to R-138) the berm and MHWL are 48.5 ft and 33.2 ft seaward of the Corps' baseline, respectively. Along the Segment II full fill (R-120 to R-124) the berm and MHWL are 50.0 ft and 35.8 ft seaward of the Corps' baseline, respectively.

Construction management of the South Reach project was by the U.S. Army Corps of Engineers, Jacksonville District. The local sponsor and FDEP permittee was Brevard County, FL. The construction contractor was Great Lakes Dredge and Dock. Olsen Associates, Inc. was the coastal engineering consultant to Brevard County.

The final construction cost for the South Reach initial construction (excluding Corps costs and expenditures by the non-federal sponsor) was approximately $ 12.7M±. The total bid value was $13,872,039. The final cost difference resulted from a slightly smaller fill volume than the contract estimate and no requirement for sea turtle trawling/relocation. The federal cost-share was 56.30 %. The County and State cost-share was 21.85 % each.

The federal authorized project is to maintain a sand berm at +10 ft-MLW that extends to the location of the pre-project MHWL. This is the equivalent of an average 70-ft advance of the pre-project MHWL. The U.S. Army Corps of Engineers' (USACE) nominal prediction of renourishment requirements is 601,000 cy in 6-year intervals.

Beach profile monitoring surveys will be repeated at FDEP R-monuments R-116 to R-143 in approximately May, 2004. This will represent the one-year post-construction survey for long-term monitoring purposes.

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1.0 SCOPE AND AUTHORIZATION OF STUDY

This engineering report summarizes the post-construction, physical aspects of the 1.6 million cubic yard (Mcy) initial nourishment of the Brevard County Federal Shore Protection Project, South Reach, as stipulated in Florida Dept. of Environmental Protection (FDEP) permit 0137212-008-JC. Project construction was completed in April, 2003. This report addresses:

(1) South Reach initial beach nourishment construction activities;
(2) monitoring activities conducted to-date and scheduled future monitoring activities;
(3) volumetric and planform beach changes associated with project construction, based upon comparison of pre- and post-project beach profile surveys;
(4) excavation of the Canaveral Shoals II and Space Coast Shoals II sand borrow areas, based upon pre- and post-project hydrographic surveys;
(5) construction and use of the Nearshore Disposal and Sand Rehandling Area (SNDSRA), based upon pre- and post-project hydrographic surveys;
(6) summary of turbidity measurements during construction; and
(7) grain size and mineralogic data of the beach fill material, based upon sediment samples from the constructed berm and borrow areas.

This study was prepared for the Brevard County Natural Resources Management Office, with joint funding from Brevard County and FDEP. The project managers for Brevard County and FDEP, respectively, were Ms. Virginia Barker/Mr. Michael McGarry, and Mr. D. Russell Snyder/Mr. Phil Sanders. The Principal Investigators for Olsen Associates, Inc. were Dr. Kevin Bodge and Mr. William Hobensack.

2.0 INTRODUCTION

2.1 Overview

This monitoring report describes the initial construction of the Brevard County Federal Shore Protection Project – South Reach (also known as "Phase II" of the project). This project involved the placement of approximately 1.6 million cubic yards (Mcy) of beach nourishment sand along approximately 3.8 miles of the Brevard County Atlantic Ocean shoreline. The project spans FDEP monuments R-118.3 to R-139, Brevard County, Florida.

The South Reach project was constructed in two segments to comply with permit conditions that restrict beach fill placement during marine turtle nesting season. Segment I (R-122.5 to R-139) was constructed from February 2002 through April 2002. Segment II (R-118.3 to R-123.5) was constructed in March/April 2003.

The project utilized sand dredged from the Canaveral Shoals II and Space Coast Shoals II borrow areas, the former located in federal waters. Construction of the project included use of a Nearshore Disposal and Sand Rehandling Area (SNDSRA). Sand was placed upon the seabed within the SNDSRA by hopper dredge, and subsequently placed onto the beach by cutterhead dredge. Segment II construction was by direct hopper dredge pump-out onto the beach.

In this report, the physical aspects of the project are described through comparison of beach profiles taken immediately before and after construction and from post-construction sediment data. Surveyed changes in the seabed across the offshore borrow areas and the SNDSRA are also described.

The Brevard County Federal Shore Protection Project – South Reach project is a federal shore protection project authorized in 1996 (USACE, 1996). The project was constructed by the U.S. Army Corps of Engineers, Jacksonville District. The Local Sponsor is Brevard County. Project costs are shared by the Federal Government (56.3 %), Brevard County (21.85 %) and the State of Florida (21.85 %) Olsen Associates, Inc. was the coastal engineering consultant for Brevard County and Great Lakes Dredge & Dock Co. was the construction contractor.

2.2 Geographic Setting

Brevard County is located along Florida's Atlantic Coast approximately 200 miles north of Miami (**Figure 2.1**). The 3.8 mile South Reach project area is located approximately 23 miles south of Port Canaveral. The project area includes the Towns of Indialantic and Melbourne Beach. The astronomical tides in the vicinity of Port Canaveral are semi-diurnal and have mean and spring ranges of about 3.5 ft and 4.1 ft, respectively. Tidal datums at Port Canaveral are listed in **Table 2.1**.

Table 2.1: Tidal datums at Port Canaveral (Atlantic Coast)[1]

Datum	Elevation (FT-NGVD[2])
MHHW	+2.1
MHW	+2.0
NGVD 1929	0.0
MLW (FDEP)	-1.6
MLW (USACE Project Construction Datum)	-1.9

2.3 Regional and Prior Beach Nourishment Projects

The Brevard County Federal Shore Protection Project, as presently authorized includes two phases: the 9.4-mile long North Reach (Phase I) from R-001 to R-053, and the approximately 3.8 mile long South Reach (Phase II) from R-118.3 to R-138 (see Figure 2.1, following page). This report specifically addresses construction of the South Reach.

The North Reach project (Phase I) was constructed between October 2000 and April 2001. The project consisted of the placement of approximately 2.8 million cubic yards (Mcy) of beach nourishment sand from Port Canaveral Entrance to Patrick Air Force Base. Project costs were shared by the Federal Government (62.2 percent), Brevard County (18.9 percent), and the State of Florida (18.9 percent). Concurrently, 0.6 Mcy were placed along the 3-mile long Patrick AFB shoreline (R-053 to R-070), immediately south of the North Reach project. The Patrick AFB beach fill was 100 percent funded by the U.S. Air Force.

[1] Developed from values provided by FDEP as published on N.O.S. sheet 11478.

[2] NGVD: National Geodetic Vertical Datum of 1929 (1929 Mean Sea Level). All elevations in this report are relative to NGVD 1929 unless otherwise noted. Horizontal coordinates are referenced to the Florida State Plane Coordinate System, East Zone, North American Datum of 1983.

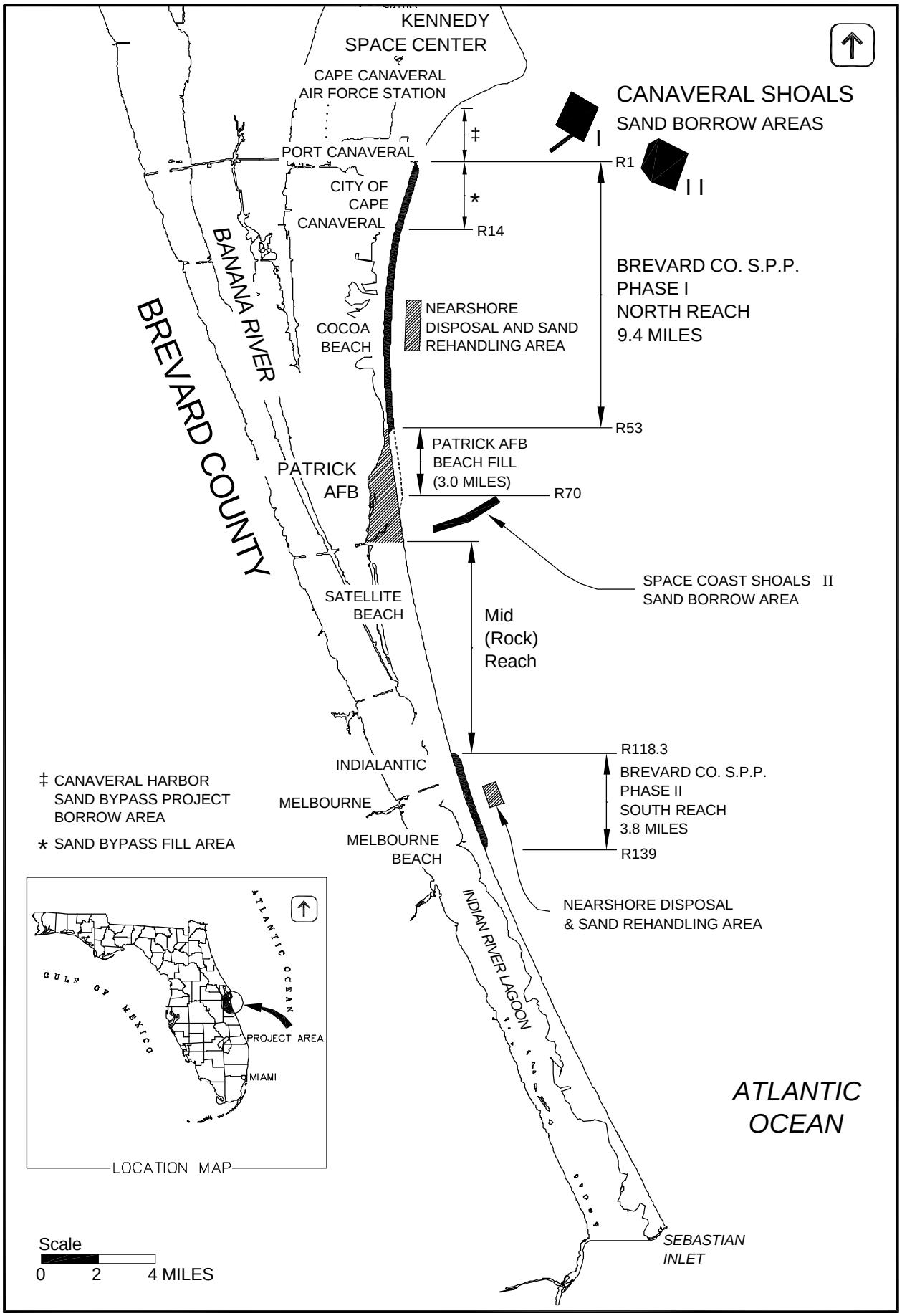

Figure 2.1: Brevard County Shore Protection Project: location map.

Within the South Reach project area the only significant prior nourishment was a 0.54 Mcy beach fill constructed between October 1980 and January 1981 from R-126 to R-136. This fill was authorized as a Federal Shore Protection Project. A comprehensive listing of beach nourishment activity along the Brevard County shoreline is provided as **Table 2.2**. Small-scale dune fill projects are not listed.

Table 2.2: Beach fill activities along the northern Brevard County, FL shoreline.

Year	Start Date	Complete Date	Location	Monuments	In-Place Volume (CY)	Effective[3] Volume (CY)
1972	Mar-72	Sep-72	Cape Canaveral	R-000 to R-014	200,000	200,000
1974	Apr-74	Nov-74	Cape Canaveral	R-000 to R-014	2,850,000	2,850,000
1980	Oct-80	Jan-81	Ind/Melbourne	R-126 to R-136	540,000	540,000
1992	Jun-92	Aug-92	Cocoa Beach*	R-028 to R-031	158,000	79,000
1993	Jul-93	Nov-93	Cocoa Beach*	R-028 to R-031	200,000	50,000
1994	Feb-94	Apr-94	Cape Canaveral	R-005 to R-011	100,000	100,000
1994	Oct-94	Nov-94	Cocoa Beach*	R-028 to R-031	135,000	68,000
1995	Jan-95	May-95	Cape Canaveral	R-000 to R-008	783,000	783,000
1995	Aug-95	Dec-95	Cocoa Beach*	R-028 to R-031	322,990	122,000
1980-1995	NA		Patrick AFB	R-053 to R-075	380,000	380,000
1996	Feb-96	Mar-96	Cocoa Beach	R-034 to R-038	40,000	40,000
1998	Apr-98	Jun-98	Cape Canaveral	R-000 to R-014	1,035,000	1,035,000
1996-1998	NA		Patrick AFB	R-053 to R-075	250,000	250,000
2001	Dec-00	Apr-01	Patrick AFB	R-053 to R-075	541,000	541,000
2001-2002	Oct-00	Apr-01	North Reach	R-003 to R-053	2,798,000	2,798,000
2002-2003	Feb-02	Apr-03	South Reach	R-118.3 to R-139	1,346,000	1,346,000
2003	July-03	Aug-03	Cocoa Beach*	R-028 to R-139	50,000	35,000

* Nearshore disposal of maintenance-dredged sand from Port Canaveral Entrance.

[3] The effective volumes are taken from Kriebel et al. (2002). The beach fills placed through nearshore disposal (in water depths of about -13 to -18 ft NGVD) are only partly effective because their depth of placement puts much of the sand outside of the active profile. As a result, the effective fill volumes are smaller than the placed volumes.

3.0 PROJECT DESCRIPTION

3.1 Overview

Initial construction of the South Reach of the Brevard County Federal Shore Protection Project consisted of the sand nourishment of approximately 20,000 ft of shoreline from FDEP Reference monument R-118 +300 ft (R-118.3) to R-139 (**Figure 3.1**). The project included a 1,200 and 1,500 ft taper at the north and south ends of the project, respectively. The USACE plans called for the placement of approximately 1.6 million cubic yards (Mcy). The fill was to be placed hydraulically in the form of a 90 to 125 ft wide "construction berm" at an elevation of +8.1 ft-NGVD (+10.0 ft-MLW), with a 1:15 seaward slope (**Figure 3.2a**). A small dune feature was added at the request of the County because of the potential for the design berm to overtop due to the area's normally high wave activity and the relatively steep natural nearshore profile. The central 9,500 ft of the project (R-125 to R-134.9), constructed first, was built to these specifications. Thereafter, two construction modifications[6] were made to the construction template as follows:

- From R-123.5 to R-125.0 and R-134.9 to R-139 the berm elevation was increased by 0.8 ft to +8.9 ft-NGVD (+10.8 ft MLW) as shown in **Figure 3.2b**. Additionally, the net berm width was decreased by 5 ft resulting in no net change of the template volume. The dune feature was unchanged.

- From R-118.3 to R-123.5 the landward edge of the berm was raised to an elevation of +9.6 ft-NGVD (+11.5 ft-MLW) while the seaward edge remained at +8.1 ft-NGVD as shown in **Figure 3.3c**. In this way, the berm was gently sloped (1:67) over the seaward 100 ft of the berm. Additionally, the dune feature was raised 1 ft with the crest of the dune at an elevation of +11.6 ft-NGVD (+13.5 ft-MLW). These changes resulted in an increase of the net template volume (about +3 cy/ft). This represented the first known shore protection project in Florida to purposely slope the berm seaward at gentle grade.

Figure 5.1, page 25, illustrates the locations and sequence of construction for these three beach fill templates.

[6] The purpose of the berm modifications was to improve the project's physical performance and longevity and to improve turtle nesting success. Observations immediately following the first weeks of beach fill construction confirmed that the initial design construction berm of +8.1 ft-NGVD (+10.0 ft-MLW) was prone to wave overtopping during spring tides and modest surf. Where the berm was lower (+8.1 ft), wave overtopping led to significant ponding of water across the berm, leading to frequent and severe run-outs that rapidly eroded the berm. In addition, the ponding presented a potential for prolonged seawater inundation of existing marine turtle nests (thereby increasing the potential for drowning of the eggs/hatchlings) and increased occurrence of non-nesting emergences (false crawls). The elevation of the landward edge of the fill was prescribed by the construction easements obtained from the upland property owners.

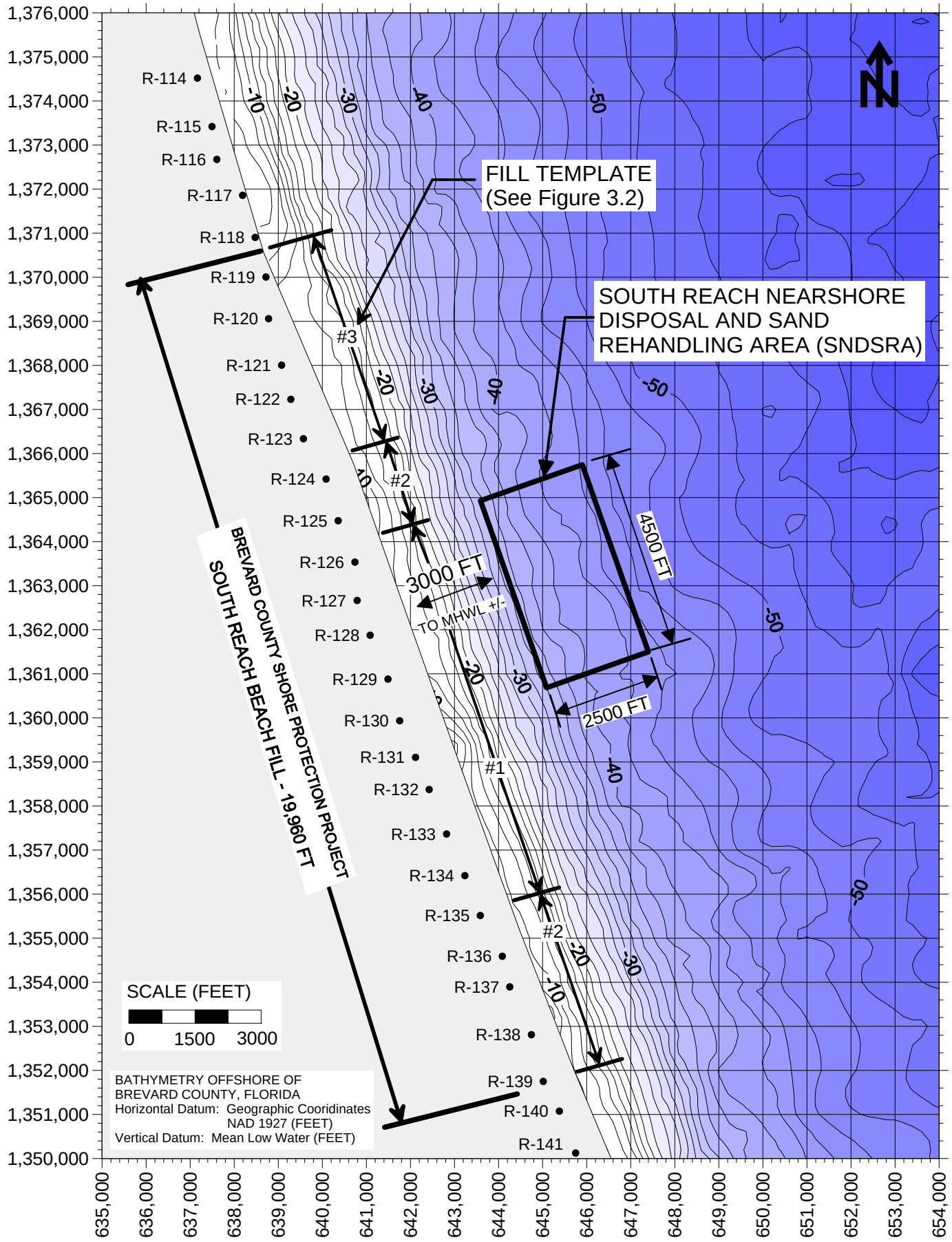

Figure 3.1: Brevard County South Reach project location and offshore bathymetry.

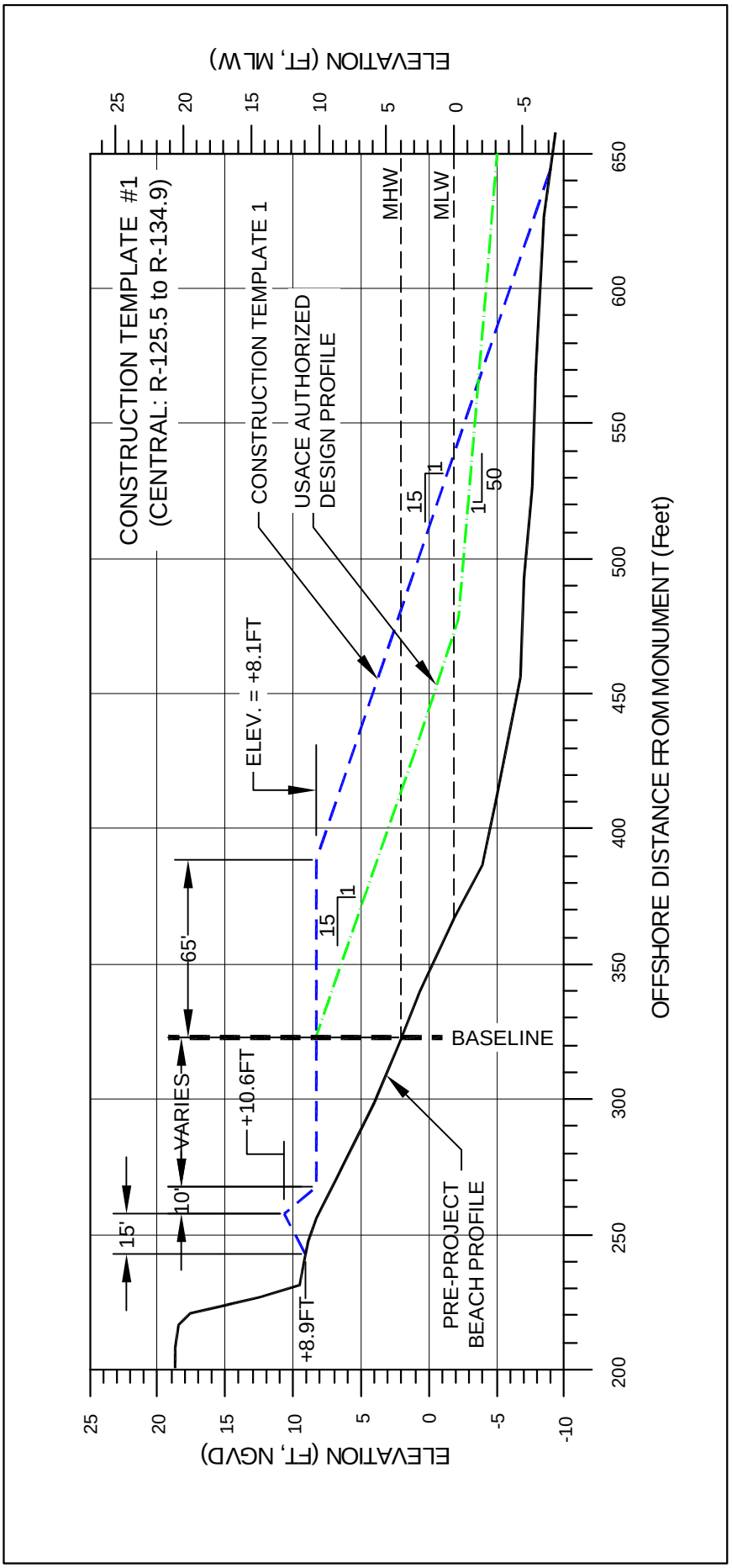

Figure 3.2 (a): Sketch of authorized project and construction berm (Template 1: R-125.5 to R-134.9).

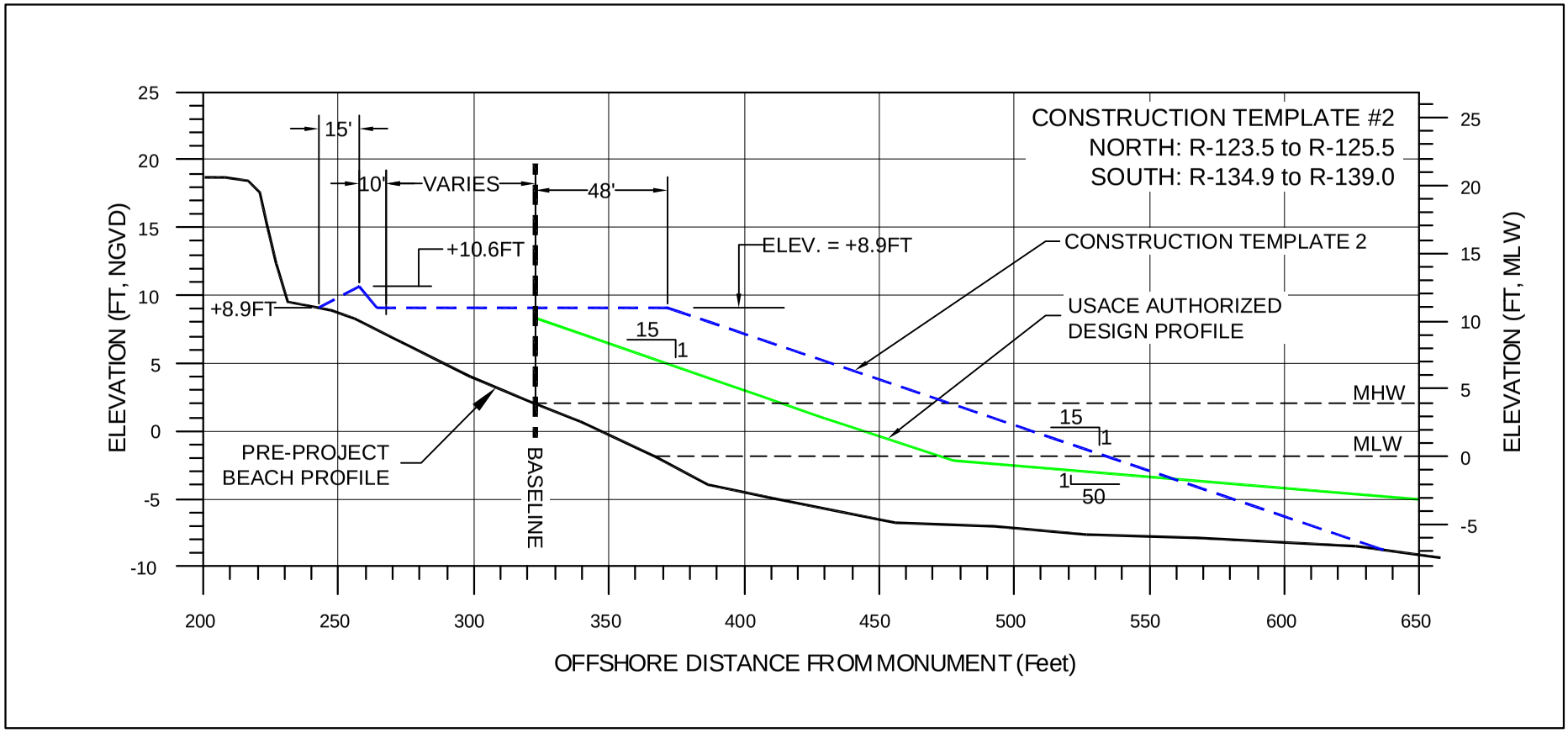

Figure 3.2 (b): Sketch of authorized project and construction berm (Template 2 : R-123.5 to R-125.5 & R-134.9 to R-139).

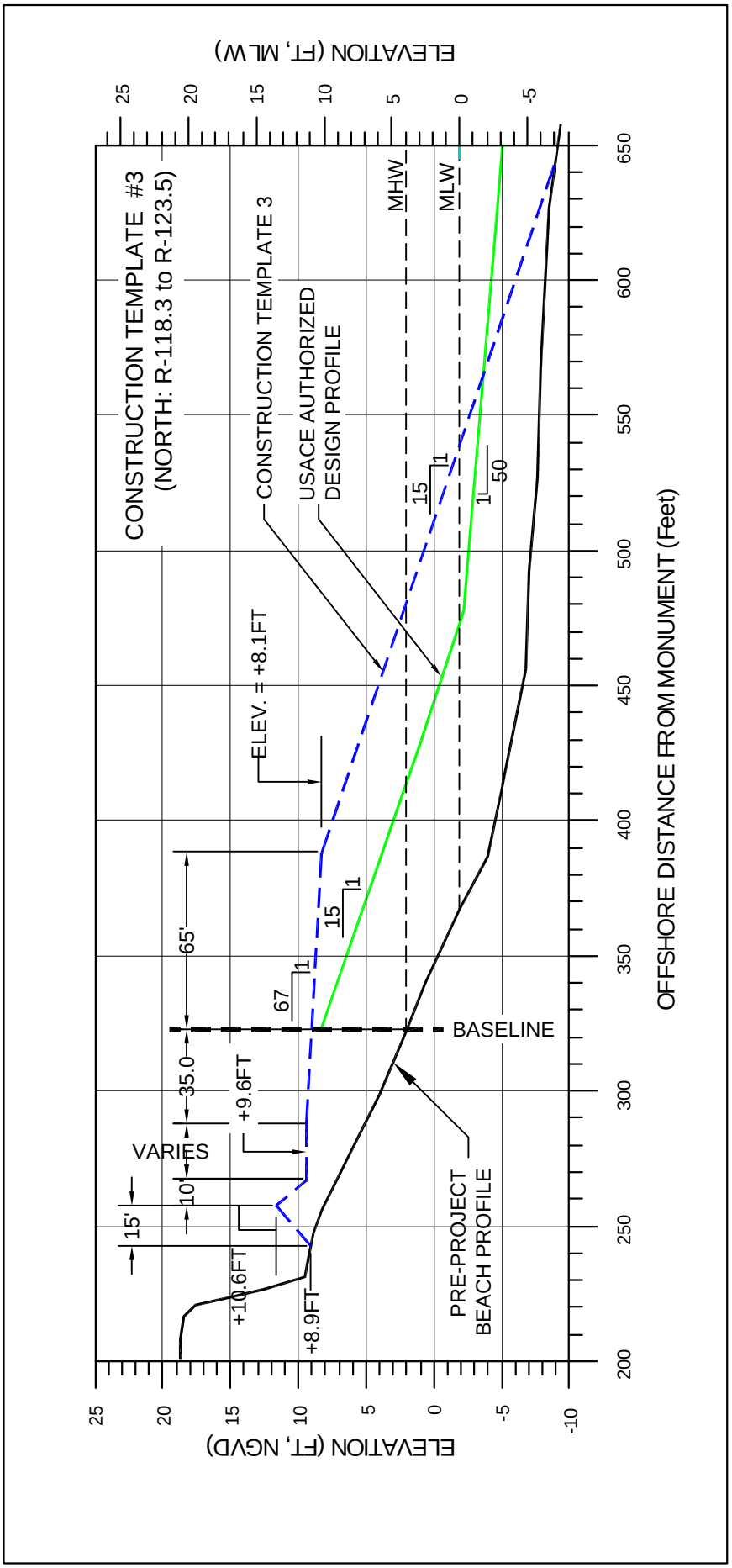

Figure 3.2 (c): Sketch of authorized project and construction berm (Template 3: R-118.3 to R-123.5).

3.2 Description of the Federal Authorized Design Project

Authorized Design Project. Section 101(b)(7) of the Water Resources Development Act of 1996 (WRDA 1996), Public Law 104-303, authorized construction of the Brevard County project for storm damage reduction and shoreline protection (USACE, 1996). The federal authorized project, or Corps' "design project" is a sand berm at elevation +8.1 ft-NGVD (+10 ft-MLW) extending to the pre-project mean high water line (MHWL), with 1:15 seaward slope to the location of mean low water (MLW), thence with 1:50 slope. See **Figure 3.2**. Beyond this is placed advance nourishment, which is allowed to erode before the next periodic renourishment. It is the Corps' intent that the "design project" be maintained; i.e., such that renourishment shall be required when the beach is substantially eroded near to, or landward of, the "design project" template. The location of the pre-project MHWL – which defines the location of the seaward edge of the design berm that is to be maintained – was established by the Corps during preparation of the project's construction documents. For these purposes, the MHWL was determined from the Corps' beach profile surveys, collected at 500-ft approximate alongshore spacing in December 2000 / January 2001. The MHWL is defined by the Corps as the "project baseline" in the construction plans, and is reproduced as **Table 3.1**, below. In this regard, the Corps refers to the design project as a "zero-ft berm". That is, the design berm, at +10 ft MLW elevation, is to be maintained at a distance of zero feet seaward of the pre-project mean high water line.

Federal Baseline Vs. Erosion Control Line. For purposes of the federal "design project", the pre-project MHWL (or baseline, as listed in Table 3.1) is *not* identical to the State of Florida Erosion Control Line (ECL). The ECL along the project area consists of a prior line in the central fill area to which was appended a northern and southern extension in 2001. The ECL coordinates are listed in **Table 3.2**.

Fill Requirements. The Corps' Feasibility Study (USACE, 1996) called for a total initial fill of 1,600,000 cy for the South Reach. This consisted of 999,000 cy for the design fill, plus initial advance nourishment of 601,000 cy. For the proposed 6-year renourishment interval, the latter represents 100,200 cy/yr of advance fill. This is approximately equal to the Corps' predicted post-placement erosion rate.

Re-Evaluation Report. The Corps prepared a Letter Re-Evaluation Report in October, 1999, describing changes in the project since the December, 1996 authorization. This report described the addition of several project features (new borrow areas, nearshore sand rehandling area, etc.). The report also described re-computation of the federal cost-share, based upon updated evaluation of alongshore development and the adoption of a "public use easement" through which the cost of sand placed landward of the ECL can be included in federal cost-sharing. The completed federal cost share for the South Reach project was 56.30 %.

Table 3.1: USACE project baseline.

Mon[7]	Pt	Easting (FT-NAD83)	Northing (FT-NAD83)	Mon	Pt	Easting (FT-NAD83)	Northing (FT-NAD83)
R-117	1	794,557.56	1,372,044.60		24	797,833.38	1,361,615.80
	2	794,700.83	1,371,526.12	R-129	25	798,018.88	1,361,096.29
R-118	3	794,822.38	1,371,086.77		26	798,131.30	1,360,719.42
	4	794,987.48	1,370,588.53	R-130	27	798,335.70	1,360,159.32
R-119	5	795,083.07	1,370,186.08		28	798,488.72	1,359,735.23
	6	795,246.39	1,369,692.72	R-131	29	798,638.16	1,359,316.34
R-120	7	795,361.35	1,369,281.34		30	798,798.72	1,358,937.96
	8	795,494.63	1,368,836.08	R-132	31	798,925.76	1,358,580.24
R-121	9	795,682.49	1,368,232.40		32	799,100.55	1,358,071.14
	10	795,821.34	1,367,769.17	R-133	33	799,320.60	1,357,575.78
R-122	11	795,943.69	1,367,465.72		34	799,474.30	1,357,124.58
	12	796,036.65	1,366,971.76	R-134	35	799,701.88	1,356,620.51
R-123	13	796,178.23	1,366,563.29		36	799,911.12	1,356,112.39
	14	796,332.99	1,366,088.31	R-135	37	800,049.31	1,355,719.09
R-124	15	796,499.16	1,365,612.03		38	800,217.29	1,355,264.58
	16	796,591.51	1,365,177.21	R-136	39	800,428.57	1,354,773.95
R-125	17	796,752.38	1,364,664.01		40	800,539.66	1,354477.34
	18	796,987.96	1,364,094.77	R-137	41	800,666.65	1,354087.86
R-126	19	797,116.92	1,363,722.94		42	800,939.11	1,353509.39
	20	797,218.59	1,363,325.65	R-138	43	801,139.56	1,353,000.07
R-127	21	797,377.66	1,362,888.87		44	801,359.87	1,352,482.80
	22	797,511.75	1,362,402.13	R-139	45	801,555.32	1,351,963.97
R-128	23	797,622.35	1,362,089.74				

[7] Corresponding R-monument profile (approximate).

Table 3.2: Erosion Control Line (ECL) coordinates.

Point	Easting (FT-NAD83)	Northing (FT-NAD83)	Point	Easting (FT-NAD83)	Northing (FT-NAD83)
Northerly Extension of South Reach ECL[8]			Southerly Extension of South Reach ECL		
425	794,893.59	1,370,794.11	301	799,916.84	1,356,009.19
424	794,948.31	1,370,590.56	302	799,991.85	1,355,814.05
423	795,007.58	1,370,402.71	303	800,081.40	1,355,602.12
422	795,060.99	1,370,210.31	304	800,162.60	1,355,398.88
421	795,113.95	1,370,010.01	305	800,239.90	1,355203.24
420	795,164.57	1,369,808.26	306	800,321.14	1,355,006.92
419	795,228.14	1,369,620.48	307	800,394.23	1,354,794.40
418	795,294.61	1,369,431.44	308	800,475.47	1,354,609.70
417	795,357.78	1,369,238.08	309	800,566.19	1,354,405.44
416	795,413.53	1,369,045.98	310	800,652.38	1,354,192.33
415	795,466.94	1,368,843.35	311	800,727.71	1,353,996.80
414	795,522.44	1,368,645.04	312	800,812.46	1,353,796.78
413	795,594.47	1,368,420.95	313	800,907.47	1,353,585.66
412	795,662.62	1,368,221.19	314	800,980.46	1,353,395.13
411	795,724.28	1,368,033.22	315	801,051.29	1,353,190.04
410	795,780.13	1,367,838.42	316	801,121.12	1,352,993.73
409	795,846.17	1,367,629.15	317	801,206.45	1,352,795.27
408	795,908.76	1,367,446.50	440	801,146.54	1,352,979.59
407	795,975.24	1,367,258.71	441	801,211.95	1,352,799.42
406	796,031.16	1,367,071.13	442	801,290.10	1,352,620.94
405	796,077.44	1,366,885.77	443	801,371.10	1,352,445.61
Indialantic ECL[9]			444	801,443.14	1,352,275.37
NA	796,115.25	1,366,873.41	445	801,510.91	1,352,102.85
NA	796,273.09	1,366,398.98	446	801,583.67	1,351,928.87
NA	796,414.28	1,365,902.27			
NA	796,571.50	1,365,427.59			
NA	796,730.20	1,364,942.90			
NA	796,990.94	1,364,110.38			
NA	797,224.27	1,363,396.71			
NA	797,399.60	1,362,901.64			
NA	797,709.08	1,361,984.44			
NA	797,887.45	1,361,438.84			
NA	798,082.86	1,360,920.82			
NA	798,448.83	1,359,912.50			
NA	798,878.70	1,358,768.77			
NA	799,339.08	1,357,527.16			
NA	799,698.74	1,356,628.59			
NA	799,953.70	1,356,029.60			

[8] Northerly and southerly ECL extension surveys were performed by Morgan & Eklund, Inc. from January 23, 2001 through January 30, 2001 and represent the location of the MHWL (+2.01 ft-NGVD) at the time of the survey.

[9] Indialantic ECL location survey was conducted in December 1978 and represents the location of the MHWL at the time of the survey.

3.3 Predicted Project Performance

Local Sponsor Predictions. Neither the authors of this report nor the Local Sponsor (Brevard County) prepared a formal prediction of the project's performance. In acquiring FDEP permits for the project, the authors of this report predicted that the construction berm would rapidly equilibrate to about 60% to 65% of its initial width (i.e., eroding by about 30 to 40 ft within the first year after construction).

USACE Predictions. The Corps' Feasibility Study (USACE, 1996) identified the following physical data for the South Reach project, for planning purposes:

Background Erosion Rate	=	33,000 cy/yr
Post-Placement Erosion Rate	=	100,000 cy/yr
Renourishment Interval	=	6 years
Periodic Renourishment	=	601,000 cy every 6 years (100,200 cy/yr)

The advance fill and periodic renourishment volumes are identified as 601,000 per 6-yr interval (100,200 cy/yr). This volume approximately equals the Corps' anticipated project erosion rate of 100,000 cy/yr.

Spreading Effects. In the process of acquiring project permits, the Corps and County predicted the project's alongshore spreading effects north of the project area using analytical methods for approximating beach planform changes. The Corps methodology assumed equal losses from both ends of the beach fill. The results of the Corps analysis are summarized in **Table 3.3**.

Olsen (2003a) presents an analytic-model prediction of the diffusion of sand from initial construction of the South Reach project as shown in **Figure 3.3**.[10] The model simulates an initial, post-equilibration increase in shoreline width of 85-ft along a 20,000 ft (3.8 miles) project area. The subsequent annual shoreline locations are computed for six years after fill construction. In addition to the diffusive effects of the beach fill, a uniform, nominal background erosion rate of 0.5 ft/yr is presumed. In this simplistic simulation, the fill has 1200-ft tapered ends and its response is symmetric about the project area centerline. No directional bias for net transport is considered. Figure 3.3 depicts only the northern half of the fill area and its adjacent shoreline. The response of the southern half of the fill would be identical in this analytic model.

[10] Computed from a Dean-type, one-line shoreline equilibration model after LeMehaute and Soldate (1977). A diffusivity value of 0.2 ft^2/sec is used, reflecting a nominal r.m.s. wave height of 2.3 ft and a standard K=0.7 coefficient from the CERC formula. The breaking wave height to water depth ratio is 0.8, specific gravity of sand is 2.65, void allowance = 0.4, and the vertical height of the active beach profile (h*+B) = 24 ft.

Table 3.3: USACE estimate of South Reach beach fill feeder/diffusion effects.

Distance North of South Reach Beach Fill	Monument	Shoreline Position (Feet, Relative to Initial Shoreline at Years End)						
		YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 20
0	R-119	26	26	26	26	26	26	25
1,000		15	17	20	20	21	21	22
1,500	R-117 + 500	11	14	17	18	18	19	21
2,000		8	11	14	15	16	17	20
3,000		2	7	8	10	12	12	18
4,000		1	3	5	7	8	8	16
5,000		0	1	2	4	5	7	14
6,000		0	0	1	2	3	4	11
7,000	R-111	0	0	1	1	2	2	10
8,000		0	0	0	1	1	2	8
9,000		0	0	0	0	0	1	7
10,000	R-108	0	0	0	0	0	0	5

The total simulated beach fill in Figure 3.3 is about 1.6 Mcy along a 3.8-mile project area (again, of which only the northern half is shown). Including the presumed background erosion rate of 0.5 ft/yr, the initial volume loss from the total fill area is 230,000 cy in the first year, 100,000 cy in the second year, and 61,000 cy in the sixth year. The average-annual loss over 6 years is 101,700 cy/yr. This is approximately equal to the 100,000 cy/yr renourishment value presumed in the Corps' plan formulation for the South Reach project (USACE, 1996).

In this symmetric model, about half of the project-area losses (minus background erosion of 9,000 cy/yr along the fill) would comprise the "feeder" benefit to each of the adjacent shorelines; i.e., about 46,350 cy/yr to the north and 46,350 cy/yr to the south. Against a corresponding background erosion along the 7.6-mile long Mid-Reach of 18,050 cy/yr (to the immediate north of the South Reach), the *net* feeder benefit to the Mid-Reach as a whole would be about 28,300 cy/yr.

From Figure 3.3, the model results suggest a maximum diffusive-feeder effect of about 12,000 ft (2.2 miles) from the fill limits over 6 years. The model predicts discrete shoreline gains (>5 feet) within about 5,000 ft of the fill limits after the first year, with net shoreline advance/stability within about 7,000 ft of the fill limits. After six years, net shoreline advance of at least 5 ft (relative to pre-project conditions) is predicted within

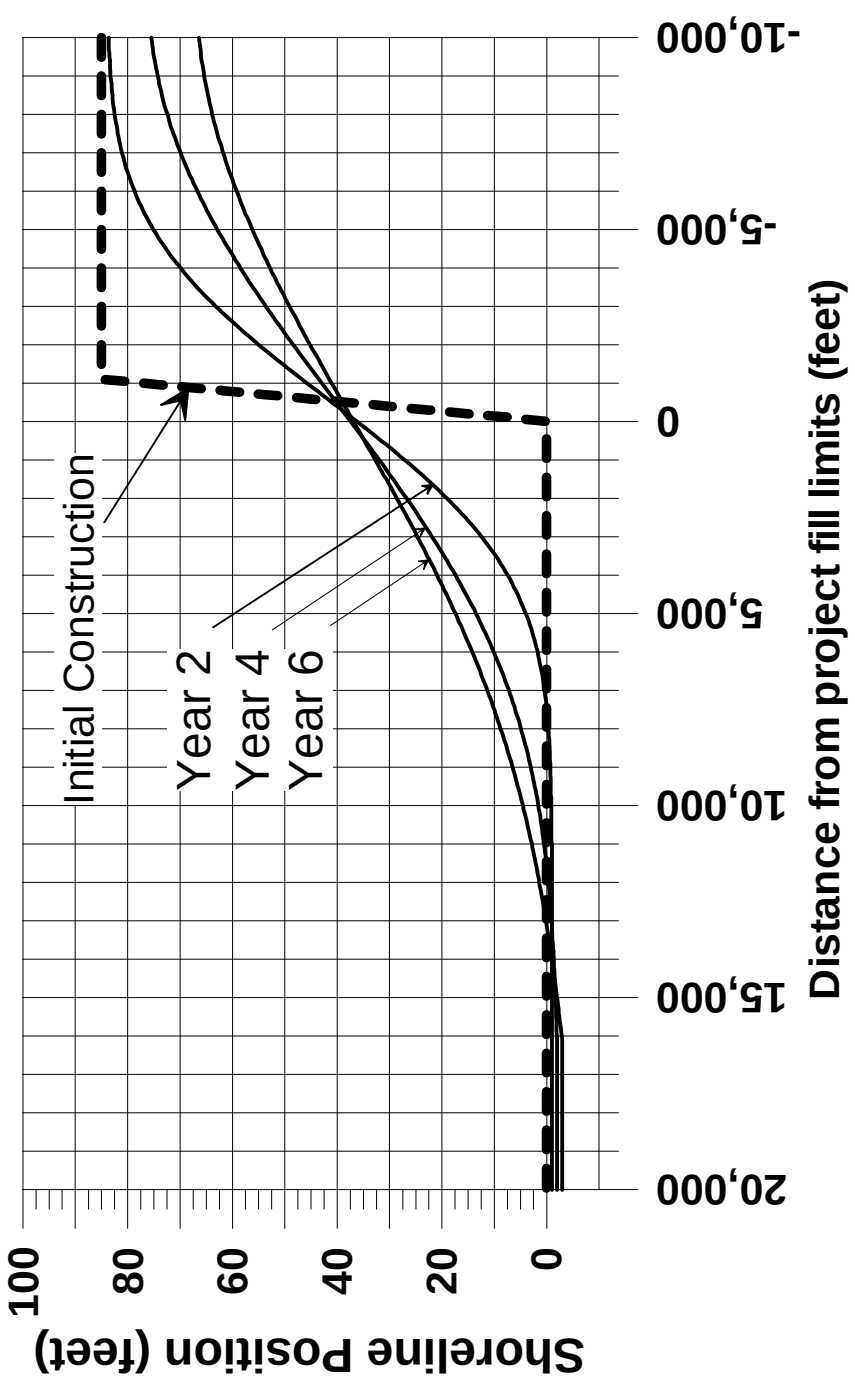

Figure 3.3: Analytic-model of diffusion effects from initial construction of the South Reach beach fill (1.6 Mcy). The figure depicts only the northern half (10,000-ft) of the fill.

10,000 feet (1.9 miles) of the fill limits and net shoreline stability might be maintained within about 12,000 feet (2.2 miles). It is important to note, however, that these are predictions from a simplistic analytic model, with no directional transport bias and no discrete storm effects. Additionally, the model predicts changes of the nominal *shoreline* location -- not the dune/bluff line. As described in Olsen (2003a), a stable berm or shoreline along the Mid Reach or Brevard's South Beaches does not necessarily prevent net recession of the dune/bluff face due to storms and wave overwash.

Historical Changes. Olsen (2002) presents pre-project, historical volume and shoreline changes along Brevard County from beach profile survey data between 1972 and 2000/01. The measured volume change (above -20 ft-NGVD) along the South Reach shoreline was a loss of 555,000 cy (19,500 cy/yr). Adjusted for the placement of beach fill during this period, the computed volumetric loss along the South Reach was 1,095,000 cy or 38,400 cy/yr. Kriebel el al (2002) concluded that the downdrift impacts of Canaveral Harbor extend 10 to 15 miles south of the Port Canaveral Entrance and therefore do not extend significantly into the South Reach project area.

4.0 PHYSICAL MONITORING PROGRAM

4.1 Monitoring Requirements

Post-construction physical monitoring requirements for the Brevard County Shore Protection Project, South Reach include those outlined in FDEP permit 0137212-008JC. Locations of R-monuments and other project features are shown in Figure 3.1 (previous section).

Beach Profile Surveys are required pre- and post-construction and annually thereafter for a period of three (3) years, then every other year thereafter until the next beach nourishment. The May 2003 survey is designated as the post-construction survey for monitoring purpose. The lines to be surveyed are FDEP R-monuments R-116 to R-143. Lines are to be 1,500-ft long or to -30 ft NGVD, whichever is further.

Borrow Area Bathymetric Surveys are required at pre, post-construction and the third annual monitoring event. Grid lines are to be at 250 ft maximum spacing extending 250 ft minimum beyond borrow area boundaries.

SNDSRA Bathymetric Surveys are required at pre-construction, post-construction, and at 45-day intervals during construction. Line spacing is to be 250-ft within work areas, 500-ft elsewhere.

Sand Samples of the constructed fill are to be collected post-construction and analyzed for grain size distribution and shell content. Two sand samples are to be taken at approximately 2000-ft alongshore spacing, 20-ft from the landward toe of dune and midway across the top of berm, 1 ft below the surface.

4.2 Monitoring Data

Data in this report address the pre- and post-construction monitoring requirements outlined above.

Beach Profile Surveys. Pre- and post-construction beach profiles surveys were conducted by Morgan & Eklund, Inc. (Wabasso, FL) for the purposes of the monitoring program outlined above. Surveys were by standard rod and level (wading) and acoustic fathometer (offshore). Unless otherwise noted, wading profiles or other "BD/AD"[13] pay profiles were not utilized in this report. The monument coordinates and survey dates are shown in **Table 4.1**. The "R" monuments are located approximately 1000-ft apart, alongshore.

[13] BD/AD: Before Dredge / After Dredge

Table 4.1: Brevard County – South Reach monitoring survey dates and locations.

Mon	Easting (ft-NAD83)	Northing (ft-NAD83)	Monitoring Survey Date[14]				
			Jan. 2002	April 2002	May 2002	March 2003	May 2003
R-116	793,840.46	1,372,836.96				**PRE**	**POST**
R-117	794,426.70	1,372,022.77				**PRE**	**POST**
R-118	794,712.33	1,371,067.88			**PRE**	PRE (II)	**POST**
R-119	794,955.12	1,370,166.10			**PRE**	PRE (II)	**POST**
R-120	795,017.60	1,369,222.42		**PRE**	POST (I)	PRE (II)	**POST**
R-121	795,313.28	1,368,168.19		**PRE**	POST (I)	PRE (II)	**POST**
R-122	795,519.98	1,367,392.32		**PRE**	POST (I)	PRE (II)	**POST**
R-123	795,805.95	1,366,499.22		**PRE**	POST (I)	PRE (II)	**POST**
R-124	796,322.14	1,365,582.42		**PRE**	POST (I)	PRE (II)	**POST**
R-125	796,594.94	1,364,637.09		**PRE**	POST (I)	PRE (II)	**POST**
R-126	796,974.98	1,363,699.80		**PRE**	POST (I)	PRE (II)	**POST**
R-127	797,025.77	1,362,826.84	**PRE**	POST (I)			**POST**
R-128	797,322.19	1,362,037.14	**PRE**	POST (I)			**POST**
R-129	797,722.96	1,361,044.51	**PRE**	POST (I)			**POST**
R-130	797,990.72	1,360,099.05	**PRE**	POST (I)			**POST**
R-131	798,370.30	1,359,259.92	**PRE**	POST (I)			**POST**
R-132	798,661.32	1,358,537.10	**PRE**	POST (I)			**POST**
R-133	799,054.92	1,357,530.11	**PRE**	POST (I)			**POST**
R-134	799,468.30	1,356,580.47	**PRE**	POST (I)			**POST**
R-135	799,819.26	1,355,679.54	**PRE**	POST (I)			**POST**
R-136	800,135.22	1,354,721.36	**PRE**	POST (I)			**POST**
R-137	800,491.33	1,354,056.50	**PRE**	POST (I)			**POST**
R-138	800,979.06	1,352,974.70	**PRE**	POST (I)			**POST**
R-139	801,250.98	1,351,911.50	**PRE**	POST (I)			**POST**
R-140	801,615.57	1,351,240.54	**PRE**	POST (I)			**POST**
R-141	801,982.99	1,350,287.78		**PRE**			**POST**
R-142	802,281.48	1,349,569.28		**PRE**			**POST**
R-143	802,648.39	1,348,656.08		**PRE**			**POST**

[14] The pre- and post-construction surveys for monitoring purposes are designated **PRE** and **POST,** respectively. Surveys designated as POST (I) were taken immediately following construction of Segment I but prior to construction of Segment II and have been used in conjunction with the **PRE** surveys to calculate the Segment I construction volumes. Surveys designated as PRE (II) were conducted immediately prior to Segment II construction and have been used in conjunction with the **POST** surveys to calculate the Segment II construction volumes.

All beach profile surveys extend seaward at least 1,500-ft or to a depth of -30.0-ft NGVD, whichever is farther. The beach profile surveys do not extend as far seaward as the Nearshore Disposal and Sand Rehandling Area (SNDSRA). (The landward boundary of the SNDSRA is in water depths of about –40 ft NGVD, or about 3,000-ft from the R-monuments.) Therefore, changes in the seabed associated with use of the SNDSRA during project construction were *not* inadvertently included in the beach fill volumetric analysis.

The pre- and post-construction surveys were not collected at two uniform dates (see Table 4.1). Instead, surveys were collected as weather permitted, prior to, and just after, beach fill construction along each major segment of the project.

Borrow Area and NDSRA Surveys. Canaveral Shoals Borrow Area II and Space Coast Shoals II were both used for the South Reach project. Pre- and post-construction hydrographic surveys of the borrow areas and the Nearshore Disposal and Sand Rehandling Area are described in Chapters 7 and 8 of this report, respectively.

Sediment Data. Representative samples from the borrow area, hopper dredge, and South Reach beach fill berms were collected and analyzed. The results are described in Chapter 9.

Turbidity Data. Per FDEP water quality permit conditions, turbidity was measured every 6 hours in daylight during construction activity at the borrow area, rehandling area (disposal and dredging), and beach fill sites. The results are described in Chapter 10.

4.3 Beach Profile Analysis

Volume Changes. The surveyed beach profiles at each "R" monument are illustrated in Appendix A. Volume changes between surveys were computed above the following elevation datums (ft-NGVD):

- +8.6 ft (Berm plus 6" high tolerance)
- +2.0 ft (Mean High Water)
- -1.9 ft (Mean Low Water)
- -6.0 ft
- -12.0 ft
- -16.0 ft (Depth of Closure)

For the volume change calculations, the +8.6 ft datum was selected so as to be generally above the construction berm. The presumed closure depth of -16.0 ft-NGVD is a typical closure depth for this part of Florida. The landward and seaward limits of comparison for each profile are listed in **Table 4.2** and presented graphically in Appendix A. The limits were established to minimize the effect of upland and offshore survey "noise". The physical depth of closure may be greater than -16 ft; however, profile comparisons beyond -16 ft do not typically yield meaningful numeric results.

Table 4.2: Volume calculation limits of comparison as measured from the designated R-monument, along the profile azimuth.

Mon.	Distance South of R-118.3 (FT)	Landward Limit (FT)	Seaward Limit (FT)	Mon.	Distance South of R-118.3 (FT)	Landward Limit (FT)	Seaward Limit (FT)
R-116	-2,190	340	2,340	R-130	11,210	250	2,250
R-117	-1,280	0	2,000	R-131	12,110	180	2,180
R-118	-280	0	2,000	R-132	12,890	170	2,170
R-119	660	0	2,000	R-133	13,970	160	2,160
R-120	1,610	235	2,235	R-134	15,000	140	2,140
R-121	2,710	250	2,250	R-135	15,970	130	2,130
R-122	3,520	330	2,330	R-136	16,990	190	2,190
R-123	4,460	280	2,280	R-137	17,720	100	2,100
R-124	5,460	50	2,050	R-138	18,870	70	2,070
R-125	6,450	80	2,080	R-139	19,960	210	2,210
R-126	7,440	10	2,010	R-140	20,720	120	2,120
R-127	8,320	250	2,250	R-141	21,740	135	2,135
R-128	9,160	240	2,240	R-142	22,520	125	2,125
R-129	10,220	190	2,190	R-143	23,500	100	2,100

Shoreline Position Change. Changes in shoreline position at each monument were computed at each of two elevations (relative to NGVD'29):

- +7.6 ft (Berm minus 6" low tolerance)
- +2.0 ft (Mean High Water)

The first (higher) datum represents the "berm". An elevation slightly below the construction berm (+7.6 ft versus +8.1 ft to +9.6 ft) was selected to ensure that the beach fill berm was intercepted. This elevation approximately corresponds to about 1½ ft below the typical vegetation line (toe of the dune/bluff).

5.0 PROJECT CONSTRUCTION

5.1 Overview

The Brevard County South Reach project was constructed by one contract in two segments to comply with restrictions on beach fill placement during marine turtle nesting season[15]. Segment I (R-122.5 to R-139) was constructed from February through April 2002. Segment II (R-118.3 to R-123.5) was constructed in March/April 2003. The amount and delayed receipt of federal FY-2002 funds for the project did not allow for completion of construction prior to the May 1 to October 31, 2002 main marine turtle nesting season. Accordingly, the Contractor de-mobilized after Segment I of constriction, in April 2002, and remobilized for Segment II the following season, in March 2003.

Segment I was constructed entirely using the Nearshore Disposal and Sand Rehandling Area (SNDSRA). For construction of Segment I, sand was dredged from both the Space Coast Shoals II (SCS-II) and Canaveral Shoals II (CS-II) offshore borrow areas by hopper dredge and placed directly to the SNDSRA, and then re-handled onto the beach by cutterhead pipeline dredge. GLDD employed the 30" dredge *Alaska* and Island class hopper dredges (about 2600 cy nominal capacity). Segment II was constructed using direct hopper dredge pump-out from the CS-II borrow area.

The project's plans and specifications, and construction management, were provided by the United States Army Corps of Engineers (USACE), Jacksonville District, with technical review and assistance by the Local Sponsor (Brevard County). State permits, real estate acquisition, development of Canaveral Shoals II and Space Coast Shoals II borrow areas and the federal lease for the formers use, along with other key project elements, were provided by Brevard County. The project was co-funded by the USACE, Brevard County (with funds from the Space Coast Tourism Development Council), and the State of Florida (Dept. of Environmental Protection). The construction contractor, Great Lakes Dredge and Dock Company (GLDD), was selected by the Corps through a Request for Proposal (RFP) solicitation, which was revised during advertisement to a competitive bid (IFB) solicitation.

The construction contract was awarded in December 2001. The Corps initiated is Reconnaissance Report study for the project in 1986, issued the Report in 1991/92 and completed the projects authorizing document in December, 1996. First construction began with the North Reach, in October 2000. The project thus took about 14-15 years to bring to construction.

[15] Construction of the South Reach (beach fill and grading) is limited to November 1st through April 30th by U.S. Fish & Wildlife Service and FDEP permit requirements regarding marine turtle nesting protection.

5.2 Sand Borrow and Rehandling Areas

Two offshore sand sources were used for beach fill construction: Space Coast Shoals II and Canaveral Shoals II (see Figure 2.1, page 4). Both borrow areas are described in detail in Chapter 7. Almost all of the sand for the first segment of construction was dredged from the SCS-II site, with a relatively small volume (40,000 – 50,000 cy) dredged from CS-II. For the second segment of construction all of the sand was dredged from CS-II.

The South Reach Nearshore Disposal and Sand Rehandling Area was used as a temporary staging area for fill material before direct placement onto the South Reach Project Area. The SNDSRA is described in detail in Chapter 8. The SNDSRA was only used during construction of Segment I.

5.3 Construction Details and Productivity

Figure 5.1 depicts the sequence of construction for the South Reach project. Construction of the South Reach Project was divided into two calendar segments. The construction berm was built in one of three geometries specified along the project area. These are described in Figures 3.2(a)-(c), and in Section 3.1.

Segment I construction (R-122.5 to R-139) commenced on January 13, 2002 with initial loading of sand primarily from the SCS-II borrow area to the Nearshore Disposal and Sand Rehandling Area (SNDSRA). A small volume (< 50,000 cy) was placed within the SNDSRA from the CS-II borrow area. Loading of the SNDSRA was completed on April 18, 2002. The average loading rate of the SNDSRA was 22,000 cy/day (GLDD estimate).

The submerged pipeline from the SNDSRA landed at R-132 near "B Avenue" on February 25, 2002. Transfer of sand from the SNDSRA to the beach commenced on March 12, 2002 and progressed southward, reaching R-139 on March 30, 2002. On April 1 sand placement progressed northward from R-132, reaching the north terminus of Segment I (R-124) on April 24. Additionally a 1,500 ft taper was constructed to R-122.5. Final tilling and grading were completed by April 30, 2002.

The USACE pay volume for Segment I construction was 1,179,319 cy plus a non-pay volume was 17,362 cy for a total USACE placed volume estimate of 1,196,681 cy. The in-place Segment I volume, as estimated from the monitoring surveys (Chapter 6) was 1,178,700 cy. The contractor's (GLDD) haul volume estimate was 1,130,000 cy.

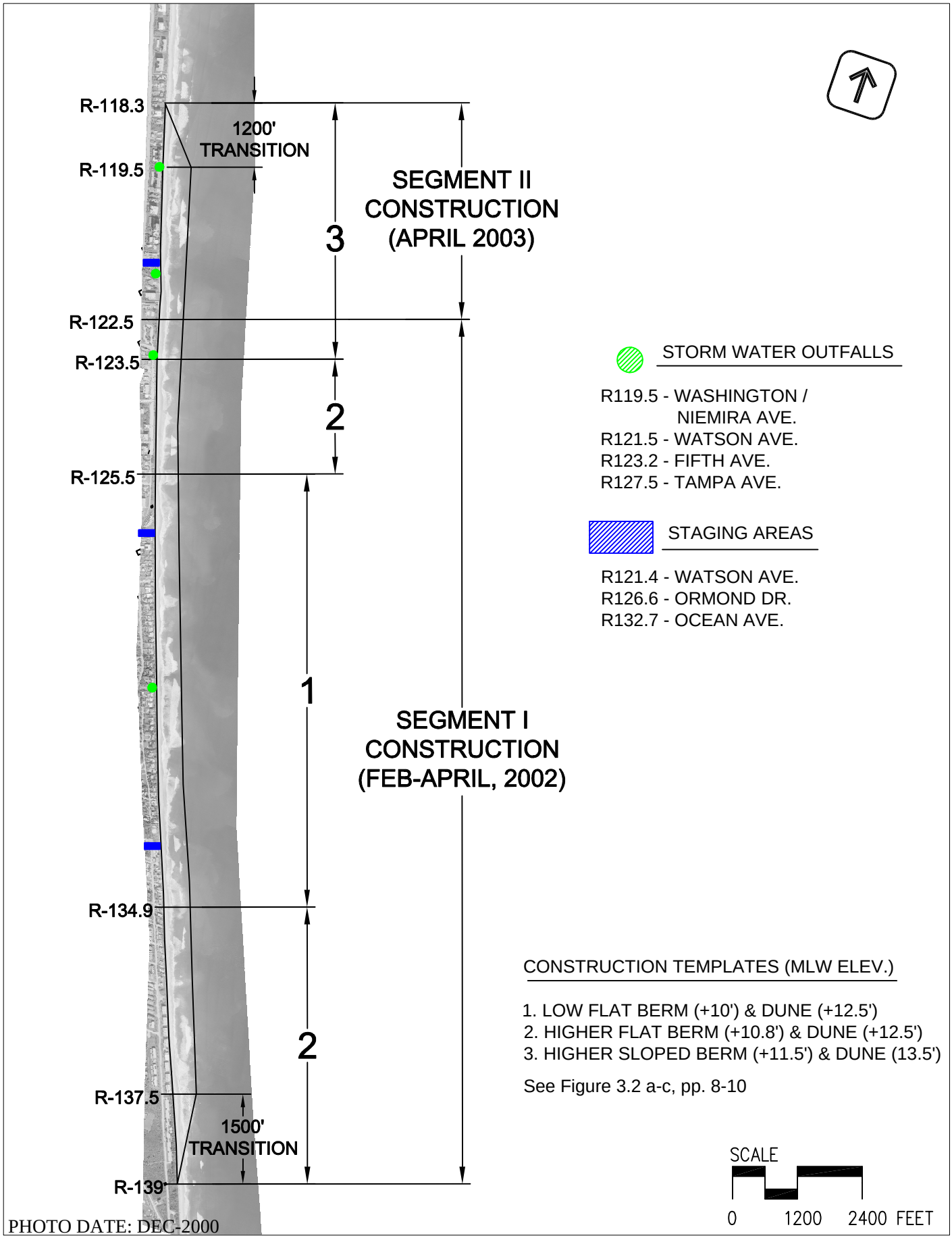

Figure 5.1: Brevard County Shore Protection Project - South Reach: sequence of construction.

Segment II construction (R-118.3 to R-123.5) commenced on March 23, 2003 with the submerged pipeline landing at R-121.2, just north of the Watson Avenue staging area. Direct hopper dredge pump-out began on March 28, 2003. Sand was initially pumped southward from R-121, reaching R-123.5 on April 10, 2003. Sand was then pumped northward from R-121, reaching R-118.3 (the northern terminus of the South Reach project) on April 27, 2003. Final tilling and grading were completed on April 30, 2003.

The USACE pay volume for Segment II construction was 324,686 cy. The placed volume, as estimated from the monitoring surveys (Chapter 6) was 280,600 cy. The contractor's (GLDD) haul volume estimate was 384,081 cy.

Total pay volume was 1,504,005 cy. The contractor's total estimated placement was 1,514,081 cy. The monitoring surveys indicate a total in-place fill volume of about 1,462,400 cy (see Section 6).

5.4 Project Construction by Bid Sub-Reach

The South Reach project was broken into four components for contractual purposes: (1) Base Bid – R-128 to R-139, (2) Option A – R-126 to R-128, (3) Option B - R-122 to R-126, and (4) Option C – R-118.3 to R-122.

Base Bid. The Base Bid consisted of the 10,800 ft of shoreline between R-128 to R-139. This component was constructed during Segment I between March 12 and April 16, 2002. The contractors estimated placement within the Base Bid was 847,000 cy.

Option A. Option A consisted of the 1,720 ft of shoreline between R-126 to R-128. This component was constructed during Segment I between April 16 and April 20, 2002. The contractors estimated placement within Option A was 145,000 cy.

Option B. Option B consisted of the 3,450 ft of shoreline between R-122.5 to R-126. This component was constructed during both Segment I and II between March 12 and April 16, 2002 and April 1 and April 10, 2003. The contractors estimated total placement (Segment I & II) within Option B was 189,850 cy.

Option C. Option C consisted of the 3,990 ft of shoreline between R-118.3 to R-122.5. This component was constructed during Segment II between April 11 and April 27, 2003. The contractors estimated total placement (Segment I & II) within Option C was 273,850 cy.

5.5 Project Construction Wave Climate

Seas and weather conditions were typical during construction of Segment I. The autumn preceding Segment I construction (viz., Sept. 15 – Nov 8, 2001) was unusually stormy and resulted in the most severe beach erosion experienced since the Thanksgiving Day Storm of 1984. Seas and weather conditions were typical during construction of Segment II except for an unusually strong Easter weekend storm (Apr. 18 – 20, 2003) that produce 6+ ft waves.

5.6 Construction Costs

The final construction cost for the South Reach initial construction (excluding Corps costs and expenditures by the non-federal sponsor) was approximately $ 12.7M±. The total bid value was $13,872,039. The final cost difference resulted from a slightly smaller fill volume than the contract estimate and no requirement for sea turtle trawling/relocation. The federal cost-share was 56.30 %. The County and State cost-share was 21.85 % each.

Non-construction costs associated with the Corps' and County's efforts were not available. A final audit had not been completed at the time of this report. Including mobilization and other construction costs, the equivalent unit cost of the sand (pay volume) was about $ 8.56/cy. If a second season mobilization had not been necessary the cost would have been about $ 7.98/cy

The South Reach contract construction costs, from the bid (DACW17-00-C-0035), were:

Initial Mobilization:	$ 1,166,000 (Base Bid)
	+ $ 17,000 (Option A)
	+ $ 17,000 (Option B)
	+ $ 17,000 (Option C)
Second Season Mobilization:	$ 933,000
Unit Costs for Beach Fill:	$ 7.32/cy (Base - 943,000 cy est'd)
	$ 6.84/cy (Option A & B – 403,000 cy est'd)
	$ 6.97/cy (Option C – 254,000 cy est'd)
Beach Tilling:	$ 382/acre (59 acres est'd total)
Vibration Monitoring:	$85,965
Grade Stake Recovery:	$14,500
Sea Turtle Trawling & Relocation:	$1495/day (not performed)

Two other competitive bids were also received. Each of the bids reflected direct hopper dredge pump-out (no rehandling) and totaled $15,248,600 and $17,627,550.

5.7 Storm Water Outfalls

Minor improvements were made to four storm-water runoff outfalls on the beach during project construction. The first of these was by the Town of Indialantic and Brevard County at Tampa Avenue (R-127.6), in April 2002. This consisted of the Town's extension of an outfall pipe that had been previously buried within the dune and exposed by the storms of autumn, 2001. The County then installed a percolation riser and sea oats at the end of the extended pipe.

Improvements were made at the existing outfalls at 5th Avenue (R-134.6), Watson Avenue (R-121.4), and Washington/Niemira Avenue (R-119.9), in late April 2003. These works consisted of a terminal percolation riser (to replace a concrete spillbox) at 5th Avenue, and in-line percolation risers at Watson and Washington/Niemira. A grout collar was also installed at the Tampa Avenue Outfall to repair leaks in the pipe joints. These works were constructed by GLDD as a local betterment modification to the Corps' contract. The improvements are intended to reduce the severity and frequency of berm erosion by storm water run-off from the outfalls. The County's request to extend the outfall pipes to the berm's seaward edge was denied in the project's initial permit application.

6.0 BEACH MONITORING (SURVEY) RESULTS

This section details the physical monitoring results of the Brevard County Federal Shore Protection Project, South Reach, during beach construction of Segment I (February 2002 to April 2002) and Segment II (March 2003 to April 2003). The volumetric and shoreline position changes within the project area and the adjacent shoreline are discussed below. The values are based upon the pre- and post-project beach profile surveys measured at the R-monument stations, described in **Chapter 4** and do not reflect before- and after-dredge (BD/AD) surveys utilized for construction review and payment.

6.1 Project Construction (Segment I & II)

6.1.1 Fill Volume Estimate

Segment I (R-122.5 to R-139). The sand volume placement along the 15,970 ft of Segment I shoreline is summarized in **Table 6.1** and depicted in **Figure 6.1**. The volume calculations presented in Table 6.1 are based upon the monitoring surveys conducted immediately before and after construction[16]. Approximately +1,182,900 cubic yards of sand (above -16 ft-NGVD) were placed along the Segment I shoreline. This is within 2 percent of the USACE estimate (pay + non-pay volume) of +1,196,681 cubic yards placed during Segment I construction.

Segment II (R-118.3 to R-123.5). The sand volume placement along the 4,960 ft of Segment II shoreline based upon the monitoring surveys conducted immediately before and after construction is summarized in **Table 6.2** and depicted in **Figure 6.2**. Along the principal construction area of Segment II, R-118.3 to R-123.5, comparison of the R-monument monitoring survey indicate a net volume increase of +253,000 cy and +230,900 cy, above -6 ft and -16 ft-NGVD, respectively. The profiles suggest that sand fill was additionally placed and accumulated as far south R-126[17]. The inclusion of this material indicates a net total Segment II volume increase of +310,900 cy and +279,500 cy above -6 and -16 ft-NGVD, respectively. This is about 4 to 14 percent less than the USACE pay estimate for Segment II.

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[16] For long-term physical beach monitoring of the entire South Reach project (including subsequent monitoring reports), the pre-construction survey is designated as the portions of the January, April and May 2002 surveys that were conducted most immediately prior to all South Reach project beach fill construction at a given monument as noted in **Chapter 4** except between R-116 through R-119. No complete profiles were taken at these monuments prior to the start of Segment I construction. As a result the March 2003 pre-construction (Segment II) survey was used. The post-construction survey for long-term monitoring is designated as the May 2003 monitoring survey. To estimate the sand volume placed during each segment of construction, the monitoring survey conducted most immediately prior to and after fill construction for each segment at a given monument has been used in each segment's construction volume and shoreline change calculations. The specific surveys dates used for the construction quantity estimates for Segments I and II are included in **Tables 6.1** and **6.2**, respectively. **Table 4.1** lists the pre- & post-construction survey dates for long-term monitoring.

[17] The volume increase outside of the Segment II limits may have been a result of sand transport from the construction area during the Easter weekend storm of 2003 (see Section 5.5).

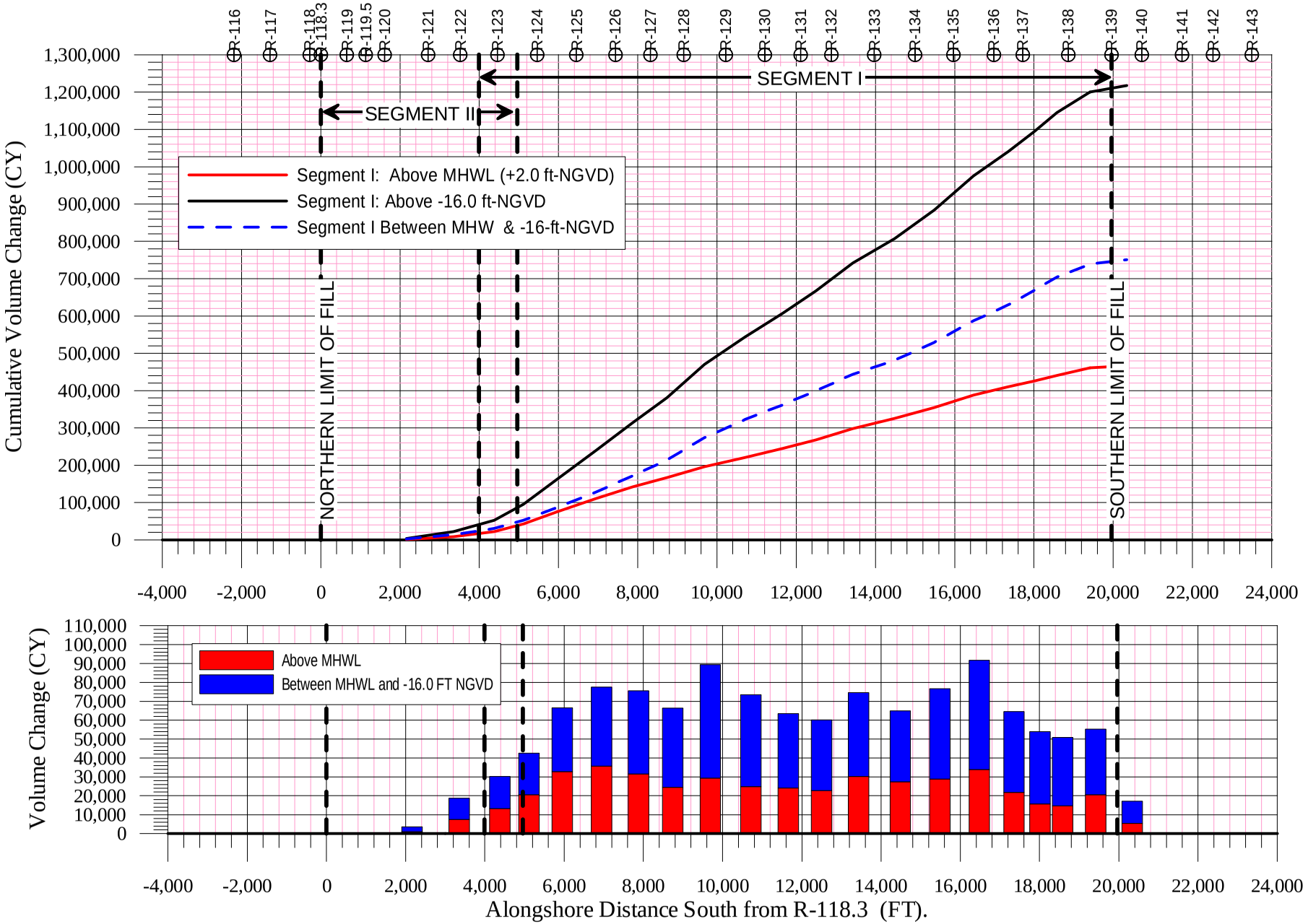

Figure 6.1: Pre- to post-construction volume change along the South Reach Project - Segment I shoreline (Jan - May 2002).

Table 6.1: Segment I volume change, pre- to post-construction based upon monitoring surveys (dates vary).

Mon.	Reach (FT)	Pre Date	Post Date	Volume Change (CY) Above Given Elevation				
				+8.6 (FT-NGVD)	+2.0 (FT-NGVD)	-1.9 (FT-NGVD)	-6.0 (FT-NGVD)	-16.0 (FT-NGVD)
R-120		04/02	05/02					
	1,100			+500	+1,000	+300	+3,200	+3,600
R-121		04/02	05/02					
	810			+300	+4,800	+6,500	+10,300	+11,900
R-122		04/02	05/02					
	470			+200	+3,600	+5,000	+7,200	+8,600
R-122.5[18]	**North End of Segment I (Start of Segment I to II Taper)**							
	470			+200	_+6,900	+10,000	+14,600	+16,600
R-123		04/02	05/02					
	300			+200	+6,100	+8,900	+12,300	+35,000
R-123.3	**South End of Segment II Construction (End of Segment I to II Taper)**							
	700			+1,200	+20,500	+30,400	+39,800	+42,500
R-124		04/02	05/02					
	990			+2,700	+32,800	+49,500	+64,200	+66,600
R-125		04/02	05/02					
	990			+2,700	+35,700	+55,800	+75,800	+77,500
R-126		04/02	05/02					
	880			+1,500	+31,600	+50,900	+71,100	+75,600
R-127		01/02	04/02					
	840			+900	+24,500	+41,400	+61,500	+66,400
R-128		01/02	04/02					
	1,060			+1,300	+29,300	+51,500	+81,600	+89,300
R-129		01/02	04/02					
	990			+600	+24,800	+43,000	+69,600	+73,400
R-130		01/02	04/02					
	900			+500	+24,100	+39,900	+61,500	+63,500
R-131		01/02	04/02					
	780			+500	+22,800	+37,100	+53,800	+60,200
R-132		01/02	04/02					
	1,080			+500	+30,200	+49,300	+74,200	+74,600
R-133		01/02	04/02					
	1,030			+700	+27,400	+44,200	+69,900	+64,900
R-134		01/02	04/02					
	970			+2,100	+28,800	+44,100	+68,800	+76,700
R-135		01/02	04/02					
	1,020			+3,100	+33,900	+51,800	+76,800	+91,800
R-136		01/02	04/02					
	730			+900	+21,800	+34,000	+49,100	+64,700
R-137		01/02	04/02					
	575			+300	+15,700	+24,900	+37,400	+54,000
R-137.5	**End of Southern Fill Taper**							
	575			+700	+14,700	+24,300	+38,200	+50,900
R-138		01/02	04/02					
	1,090			+1,200	+20,600	+34,800	+56,800	+55,300
R-139		01/02	04/02	**Southern Limit of Fill (Start of Southern Fill Taper)**				
	760			+200	+5,400	+10,600	+20,600	+17,100
R-140		04/02	05/02					
Segment I Total (R-122.5 to R-139)	**15,970**			+21,600	+455,300	+715,800	+1,062,400	+1,161,500

[18] No surveys were conducted at R-122.5, R-123.3 or R-137.5. Volume calculations are based upon adjacent monuments and are weighted based upon relative distances between monuments.

Table 6.2: Segment II volume change, pre- to post-construction based upon monitoring surveys (dates vary).

Mon.	Reach (FT)	Pre Date	Post Date	Volume Change Above Given Elevation (CY)				
				+8.6 (FT-NGVD)	+2.0 (FT-NGVD)	-1.9 (FT-NGVD)	-6.0 (FT-NGVD)	-16.0 (FT-NGVD)
R-116		03/03	05/03					
	910			-100	-1,100	+800	-900	-3,400
R-117		03/03	05/03					
	1,280			-500	+2,300	+10,500	+6,900	-1,100
R-118.3[19]	**Northern Limit of Fill (Start of Northern Fill Taper)**							
	660			+1,300	+12,900	+21,500	+23,200	+19,100
R-119		03/03	05/03					
	475			+2,000	+15,000	+22,500	+26,200	+23,600
R-119.5	**End of Northern Fill Taper**							
	475			+1,700	+13,300	+21,000	+26,700	+22,500
R-120		03/03	05/03					
	1,100			+6,600	+32,900	+49,900	+66,600	+59,500
R-121		03/03	05/03					
	810			+5,600	+23,900	+34,700	+47,500	+46,100
R-122		03/03	05/03					
	470			+3,000	+11,800	+17,400	+24,600	+23,800
R-122.5	**North End of Segment I (Start of Segment I to II Taper)**							
	470			+4,000	+11,400	+16,700	+24,100	+22,900
R-123		03/03	05/03					
	300			+2,600	+6,500	+9,500	+14,100	+13,400
R-123.3	**Southern End of Segment II Construction (End of Segment I to II Taper)**							
	700			+4,500	+12,300	+18,100	+27,800	+26,900
R-124		03/03	05/03					
	990			+3,200	+8,300	+13,000	+24,700	+21,200
R-125		03/03	05/03					
	990			+1,000	-200	+1,100	+5,400	+500
R-126		03/03	05/03					
Segment II Limits Total (R-118.3 to R-123.3)	**4,960**			**+26,800**	**+127,700**	**+193,200**	**+253,000**	**+230,900**
Effected South Reach Project Area (R-118.3 to R-126)	**7,440**			**+35,500**	**+148,100**	**+225,400**	**+310,900**	**+279,500**

[19] No surveys were conducted at R-118.3, R-119.5 and R-123.5. Volume calculations are based upon adjacent monuments and are weighted based upon relative distances between monuments.

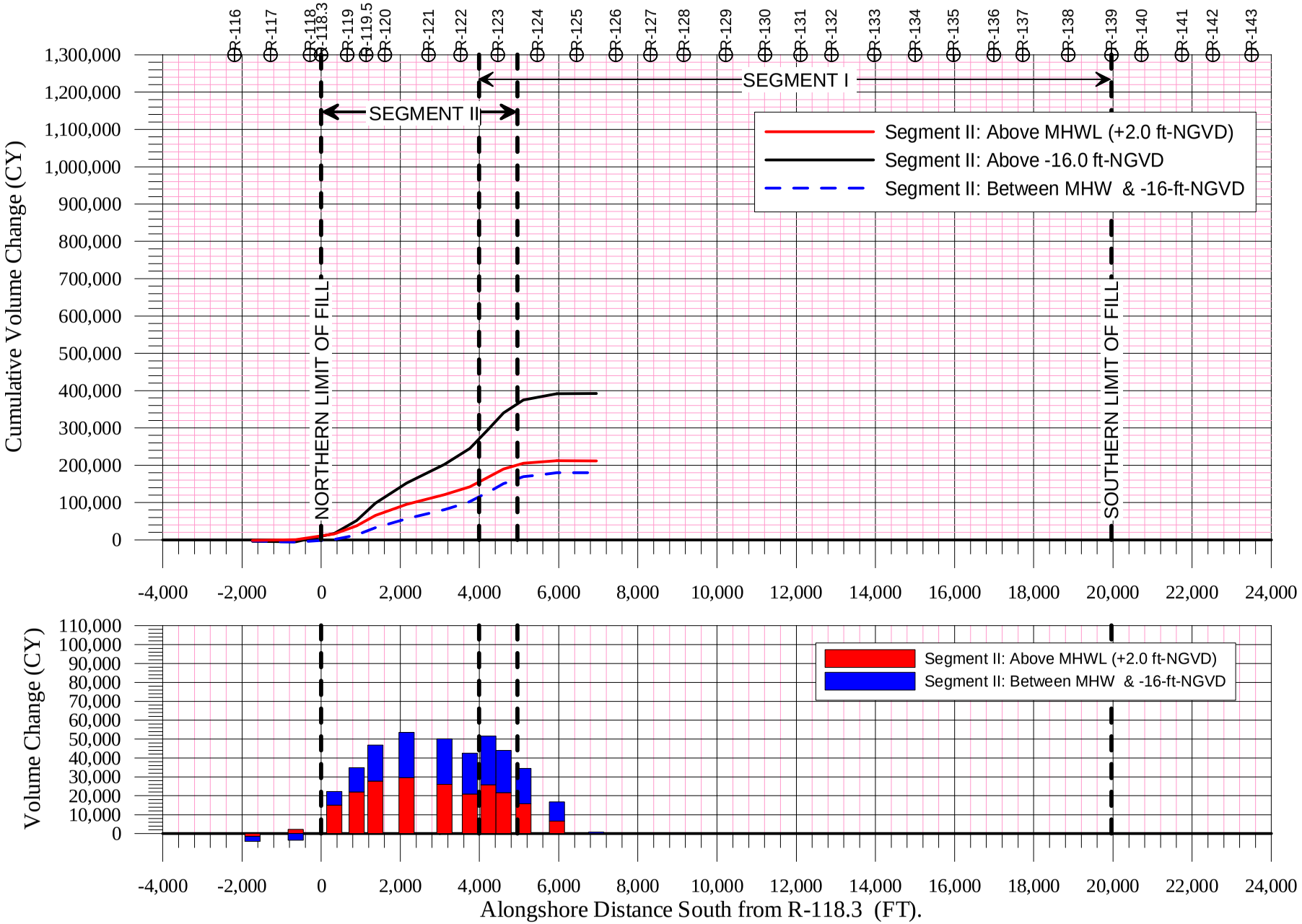

Figure 6.2: Pre- to post-construction volume change along the South Reach Project - Segment II shoreline (March 2003 - May 2003).

The total placed volume from Segment I and II construction, (R-118.3 to R-139) was 1,462,400 cy above -16 ft-NGVD, based upon the Segment I and II construction volume calculations shown in Tables 6.1 and 6.2[20]. Of this quantity, 602,900 cy were placed above MHW.

During Segment I, the net measured volume change adjacent to the construction area (R-120 to R-122.5 & R-139 to R-140) was about +36,160 cy above -16 ft-NGVD. During Segment II, there was a net measured decrease of about -4,500 cy above -16 ft-NGVD along the adjacent shoreline (R-116 to R-118.3).

6.1.2 Shoreline Change

Overall. Berm and MHWL location changes for the entire South Reach Project area are presented in **Figures 6.3** and **6.4**, respectively and summarized in **Table 6.3**. Overall, as a result of project improvements (Segments I and II), the dry-berm width (+7.6 ft-NGVD) was increased by 108.8 ft, on average. This does not include the tapers at the north and south ends of the fill. Likewise, the mean high water width (+2.0 ft-NGVD) was increased by an average of 118.5 ft.

In Figures 6.3 and 6.4 the locations of the "authorized design" berm and MHWL depict the +7.6 ft and +2.0 ft-NGVD elevations that conform to the design profile shown in Figures 3.2(a)-(c). The design profile shown was developed using the USACE baseline tabulated in Table 3.1.

Segment I. As a result of Segment I construction, the dry-berm width was increased by 113.1 ft, on average. Similarly, the mean high water shoreline was advanced seaward by an average 121.6 ft. This does not include the taper at the north end of Segment I marking the transition to Segment II or the taper at the southern limit of the project (R-138 & R-139).

Segment II. As a result of Segment II construction, the dry-berm width was increased by 80.4 ft, on average. Similarly, the mean high water shoreline was advanced seaward by an average 94.4 ft. This includes the thin fill section marking the transition between Segment I and Segment II (R-122 & R-123) but does not include the taper at the north end of the project (R-118 & R-119).

[20] Total includes approximately +42,600 cy of sand measured from R-123.3 and R-126 between March and May 2003.

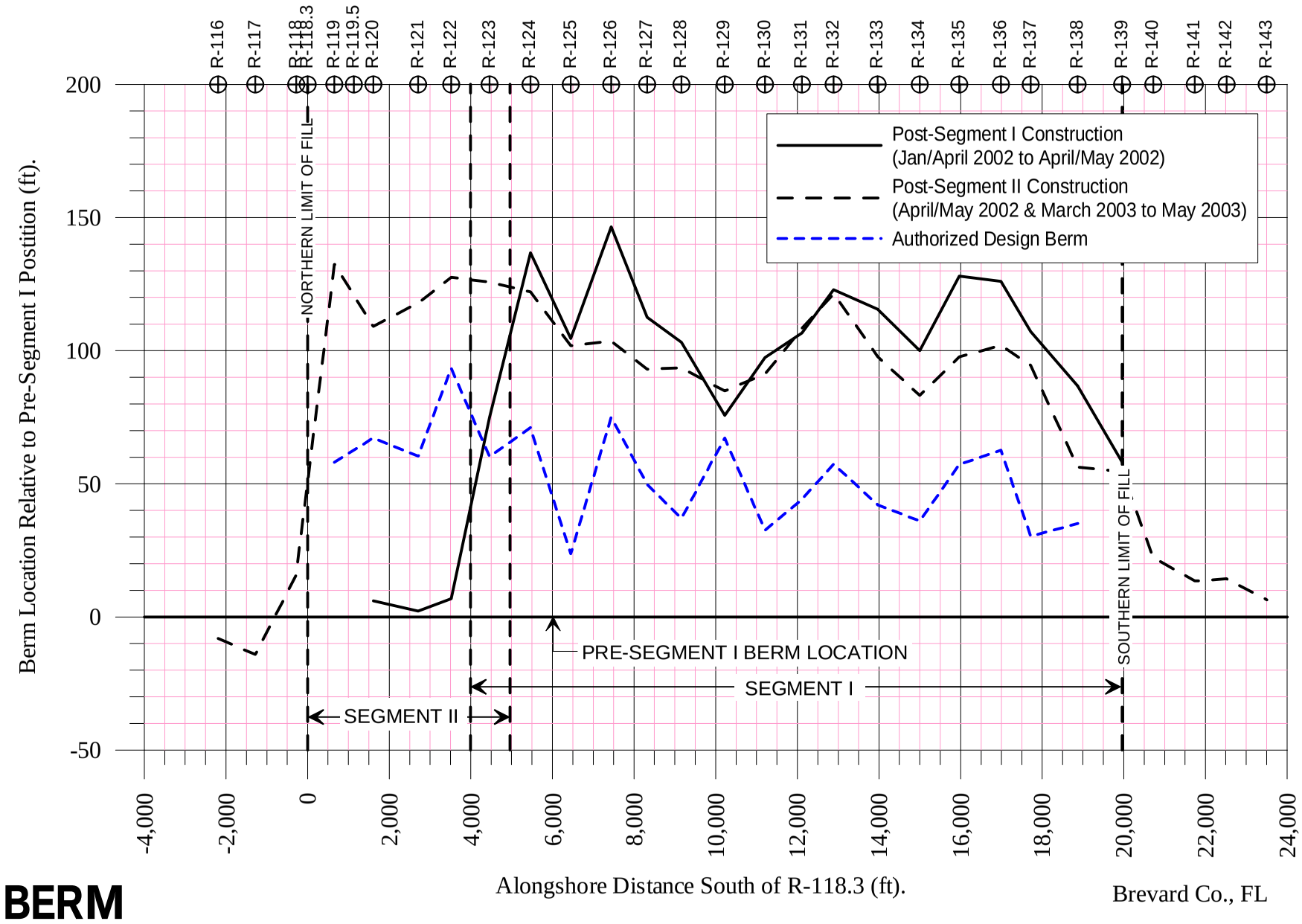

Figure 6.3: Location of the edge of the **"dry berm"** (+7.6-ft NGVD) relative to the pre-construction (monitoring) location (Jan-2002, Apr-2002, May-2002 & March 2003 surveys: see Table 4.1 for **PRE** survey dates).

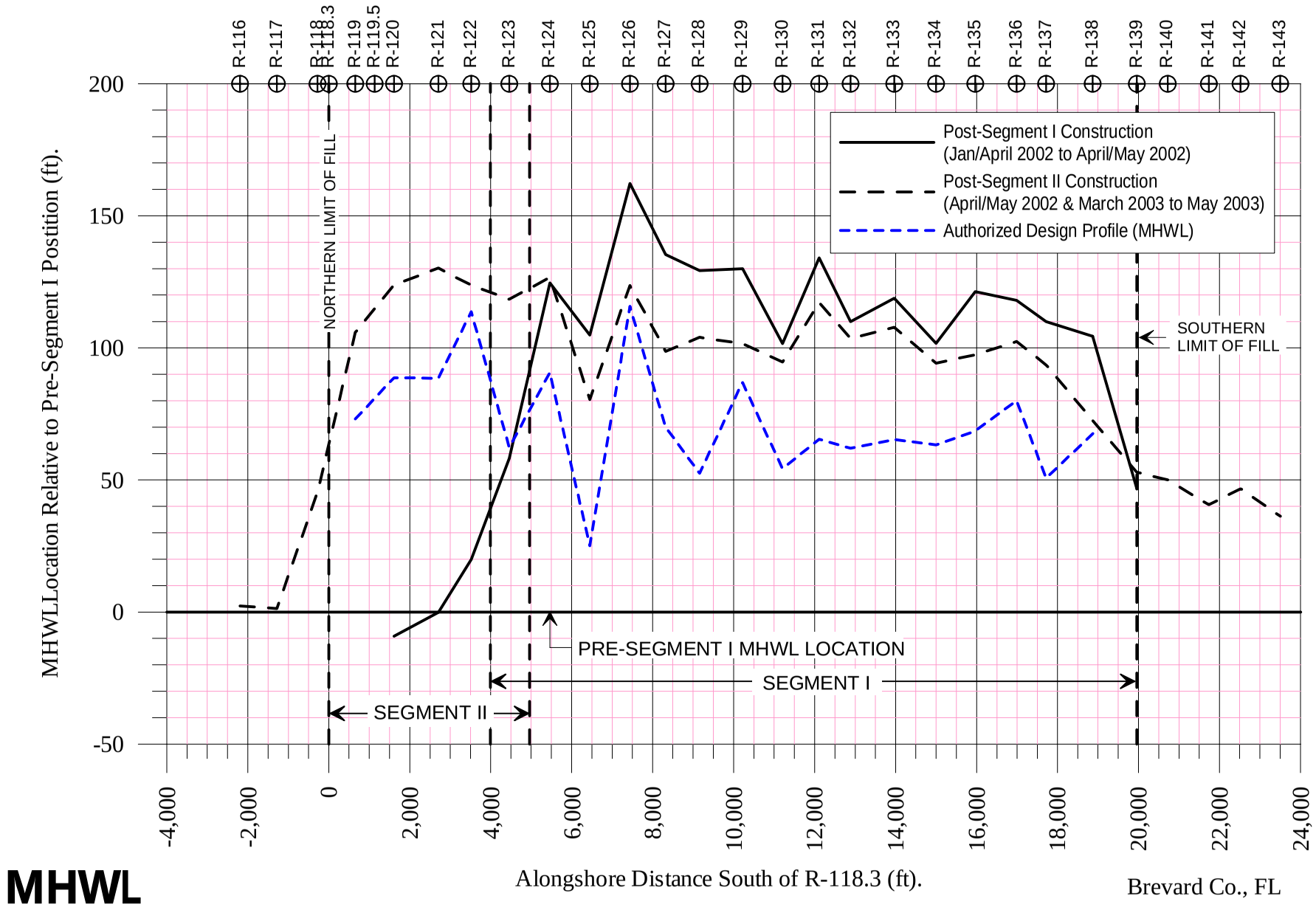

Figure 6.4: Location of the edge of the **mean high water line** (+2.0-ft NGVD) relative to the pre-construction (monitoring) location (Jan-2002, Apr-2002, May-2002 & March 2003 surveys: see Table 4.1 for **PRE** survey dates)

Table 6.3: Pre- to post-construction change of the location of the "dry-berm" (+7.6 ft-NGVD) and MHWL (+2.0 ft-NGVD).

Reach	Mon.	Distance South of R-118.3	Pre Date	Post Date	Pre to Post Change (FT) Berm (+7.6 FT-NGVD)	Pre to Post Change (FT) MHWL (+2.0 FT-NGVD)
Segment I Construction						
No Fill (Segment I)	R-120	1,610	04/02	05/02	6.0	-9.2
	R-121	2,710	04/02	05/02	2.2	-0.1
Taper	R-122	3,520	04/02	05/02	6.8	19.9
	R-123	4,460	04/02	05/02	75.0	58.2
Segment I Fill	R-124	5,460	04/02	05/02	136.8	124.6
	R-125	6,450	04/02	05/02	104.6	104.9
	R-126	7,440	04/02	05/02	146.5	162.3
	R-127	8,320	01/02	04/02	112.5	135.3
	R-128	9,160	01/02	04/02	103.1	129.3
	R-129	10,220	01/02	04/02	75.7	130.0
	R-130	11,210	01/02	04/02	97.4	101.6
	R-131	12,110	01/02	04/02	106.6	134.1
	R-132	12,890	01/02	04/02	122.9	110.0
	R-133	13,970	01/02	04/02	115.6	118.8
	R-134	15,000	01/02	04/02	100.0	101.7
	R-135	15,970	01/02	04/02	128.0	121.3
	R-136	16,990	01/02	04/02	126.0	118.0
	R-137	17,720	01/02	04/02	107.2	110.0
Taper	R-138	18,870	01/02	04/02	86.8	104.4
	R-139	19,960	01/02	04/02	58.1	46.8
Segment I Full Fill Average (R-124 to R-137)					113.1	121.6
Segment II Construction						
No Fill	R-116	-2,190	03/03	05/03	-8.1	2.3
	R-117	-1,280	03/03	05/03	-14.1	1.3
	R-118	-280	03/03	05/03	-8.9	58.4
Segment II Fill	R-119	660	03/03	05/03	120.1	108.2
	R-120	1,610	03/03	05/03	73.7	102.5
	R-121	2,710	03/03	05/03	93.0	104.9
	R-122	3,520	03/03	05/03	69.7	86.2
	R-123	4,460	03/03	05/03	45.3	70.3
No Fill (Segment II)	R-124	5,460	03/03	05/03	27.5	52.7
	R-125	6,450	03/03	05/03	-7.7	8.6
	R-126	7,440	03/03	05/03	-14.2	-0.5
Segment II Average (R-119 to R-123)					80.4	94.4
Segment I & II Average (R-119 to R-137)[21]					**108.8**	**118.5**

[21] Includes the total shoreline change (Segment I & II) at R-122 and R-123.

6.1.3 Beach Planform Area Change

Figure 6.5(a) illustrates the change in recreational beach area – or beach planform area – along the project area, pursuant to beach fill construction. This value is defined as the beach area between the berm elevation (+7.6 ft-NGVD) to the MHWL (+2.0 ft-NGVD) as illustrated in **Figure 6.5(b)**.

Overall the nourishment project (Segments I and II) increased the "dry beach" planform area from 31.1 acres to 83.7 acres; or an increase of 52.6 acres (269.1 %). Segment I construction increased the planform area from 24.2 acres to 65.5 acres; or an increase of 41.3 acres (271.0 %). Segment II construction increased the planform area from 6.9 acres to 18.2 acres; or an increase of 11.3 acres (263.8 %).

6.1.4 Segment I to Segment II Changes

Approximately one-year elapsed between completion of Segment I and construction of Segment II. The initial response of the beach fill and adjacent shoreline to the Segment I construction is described by comparison of the April/May 2002 surveys and the March/May 2003 surveys[22]. The volume changes between these surveys are listed in **Table 6.4** and illustrated in **Figure 6.6**. The corresponding berm and MHWL locations are illustrated in **Figures 6.7** and **6.8**, respectively and listed in **Table 6.5**. During this one-year interlude in construction, the following changes were observed:

- The filled Segment I shoreline (R-122.5 to R-139) exhibited an overall net losses of -55,000 cy above -16 ft-NGVD, of which -44,600 cy was above MHW. This represents net changes of 4.7 % and 9.9 % of the placed volume, respectively. The width of the placed berm decreased by -13.3 ft (13.2%) on average. The MHWL width decreased by -21.6 ft (20.1 %), on average. The beach profile data indicates that the seaward edge of the berm increased in elevation to approximately +10.0 ft-NGVD by natural wave forces during the initial year after Segment I construction.

- The beach south of the Segment I fill area (R-139 to R-143) exhibited net gains of +11,000 cy above -16 ft-NGVD and +25,900 cy above MHW. The berm and MHWL width increased by +12.8 ft and +32.2 ft, respectively.

[22] The only monitoring surveys prior to Segment II construction but after Segment I construction were conducted from R-116 to R-126 in March 2003. From R-127 through R-139, the April 2002 and May 2003 surveys were used for the Segment I to II change analysis.

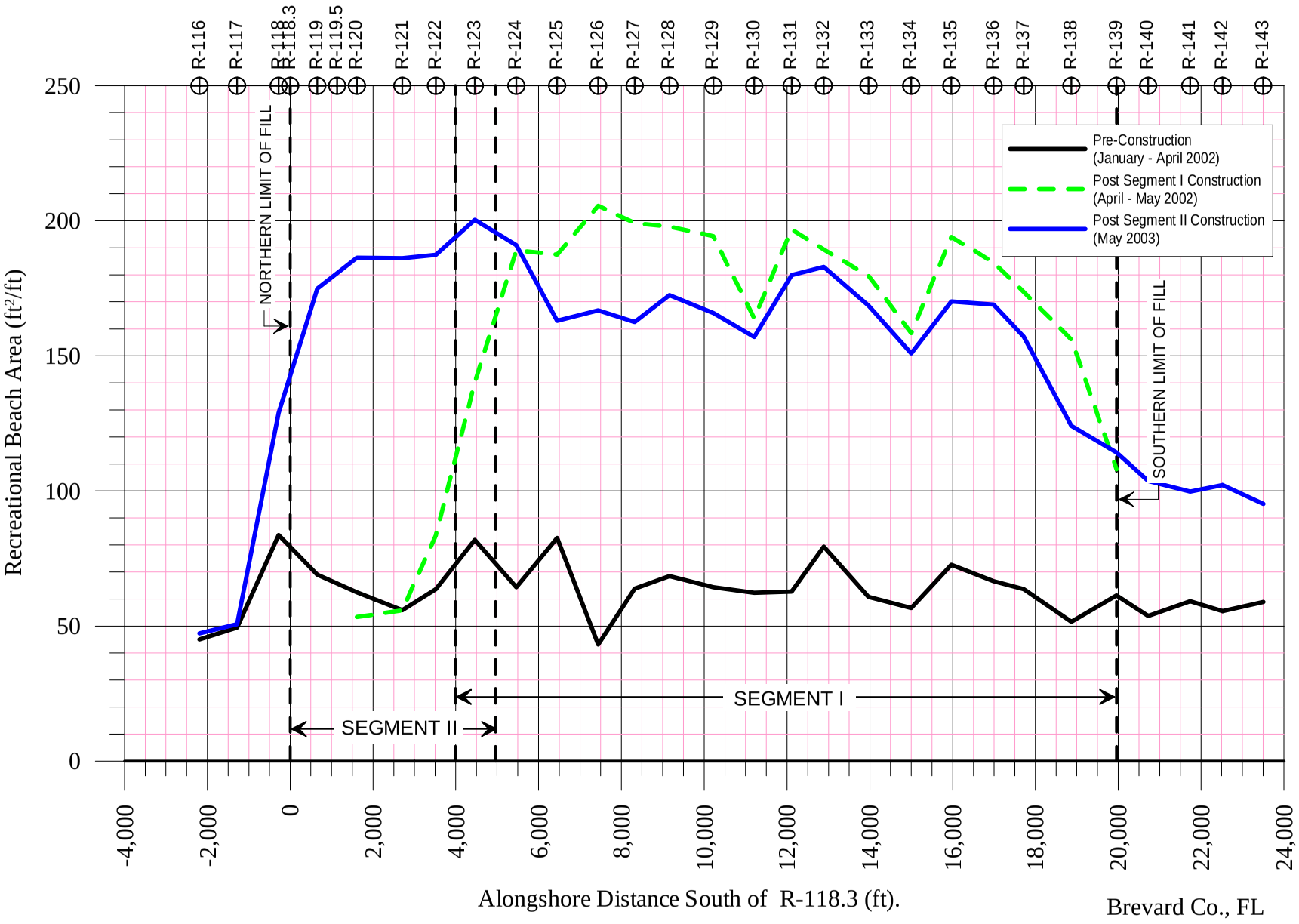

Figure 6.5a: Pre- and post- construction beach area defined as the area between the edge of the pre-construction **"dry berm"** (+7.6 ft-NGVD) and the respective **MHWL** (+2.0 ft-NGVD)

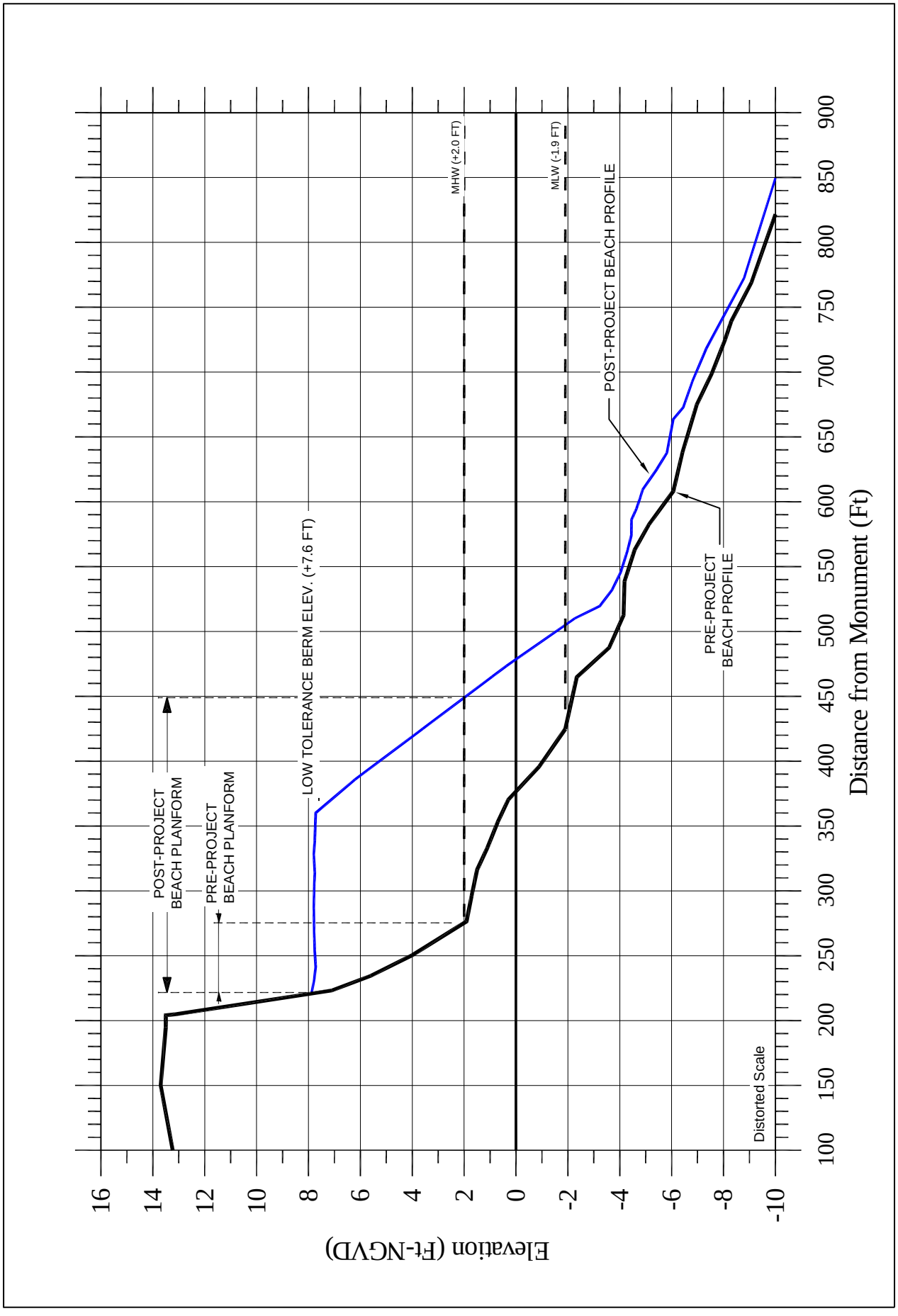

Figure 6.5(b): Definition sketch of beach planform area depicted in Figure 6.5(a).

Table 6.4: Volume changes between Segment I and Segment II construction (April/May 2002 to March/May 2003).

Mon.	Reach (FT)	Pre Date	Post Date	Volume Change Above Given Elevation (CY)				
				+8.6 (FT-NGVD)	+2.0 (FT-NGVD)	-1.9 (FT-NGVD)	-6.0 (FT-NGVD)	-16.0 (FT-NGVD)
R-118.3		05/02	03/03	**North End of Fill**				
	660			400	2,100	700	3,600	3,900
R-119		05/02	03/03					
	950			1,200	5,100	6,300	8,300	8,600
R-120		05/02	03/03					
	1100			1,100	7,900	10400	10,400	11,000
R-121		05/02	03/03					
	810			400	6,300	7,400	8,300	8,900
R-122		05/02	03/03					
	470			400	3,300	3,400	3,700	4,100
R-122.5				**North End of Segment I**				
	470			-200	400	-800	-2,000	-1,700
R-123		05/02	03/03					
	1000			-200	-6,500	-11,900	-17,000	-16,200
R-124		05/02	03/03					
	990			1,100	-7,200	-14,100	-22,600	-21,700
R-125		05/02	03/03					
	990			1,100	-6,000	-13,200	-24,900	-23,100
R-126		05/02	03/03					
	880			1,700	-5,000	-10,700	-17,900	-6,300
R-127		04/02	05/03					
	840			1,600	-1,900	-6300	-10,400	5,200
R-128		04/02	05/03					
	1060			500	-2,600	-8600	-17,900	-4,600
R-129		04/02	05/03					
	990			1,100	-1,300	-4900	-14,300	-4,000
R-130		04/02	05/03					
	900			1900	400	-1000	-5,900	6,600
R-131		04/02	05/03					
	780			1200	400	-400	-600	10,000
R-132		04/02	05/03					
	1080			1800	300	-600	-2,900	16,300
R-133		04/02	05/03					
	1030			2300	-200	-1,500	-10,200	9,700
R-134		04/02	05/03					
	970			1400	-3,000	-4,600	-13,100	-6,800
R-135		04/02	05/03					
	1020			2800	-3,800	-6,100	-9,400	-5,500
R-136		04/02	05/03					
	730			2500	-1,000	-2,500	-2,100	-4,500
R-137		04/02	05/03					
	1150			2100	-5,000	-8,900	-10,600	-15,700
R-138		04/02	05/03					
	1090			1800	-2,600	-5,200	-7,000	7,300
R-139		04/02	05/03	**South End of Fill**				
	760			1300	4,800	5,800	6,700	10,200
R-140		04/02	05/03					
	1020			300	8,900	12,900	16,600	-3,300
R-141		04/02	05/03					
	780			-300	5,700	9,800	10,700	-1,700
R-142		04/02	05/03					
	980			-200	6,500	9,900	8,800	5,800
R-143		04/02	05/03					

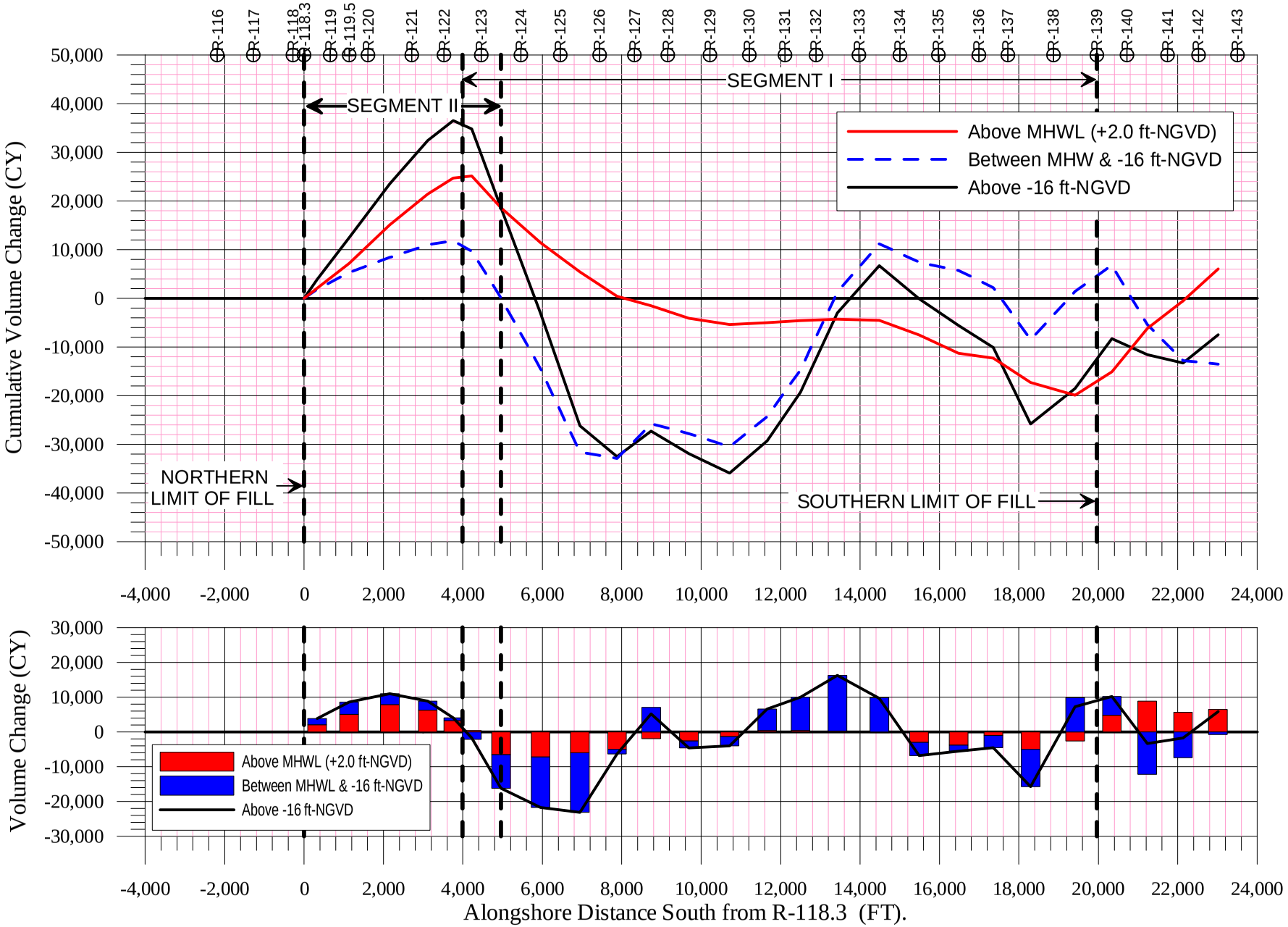

Figure 6.6: Volume changes between construction of Segment I & Segment II (April/May 2002 to March/May 2003)

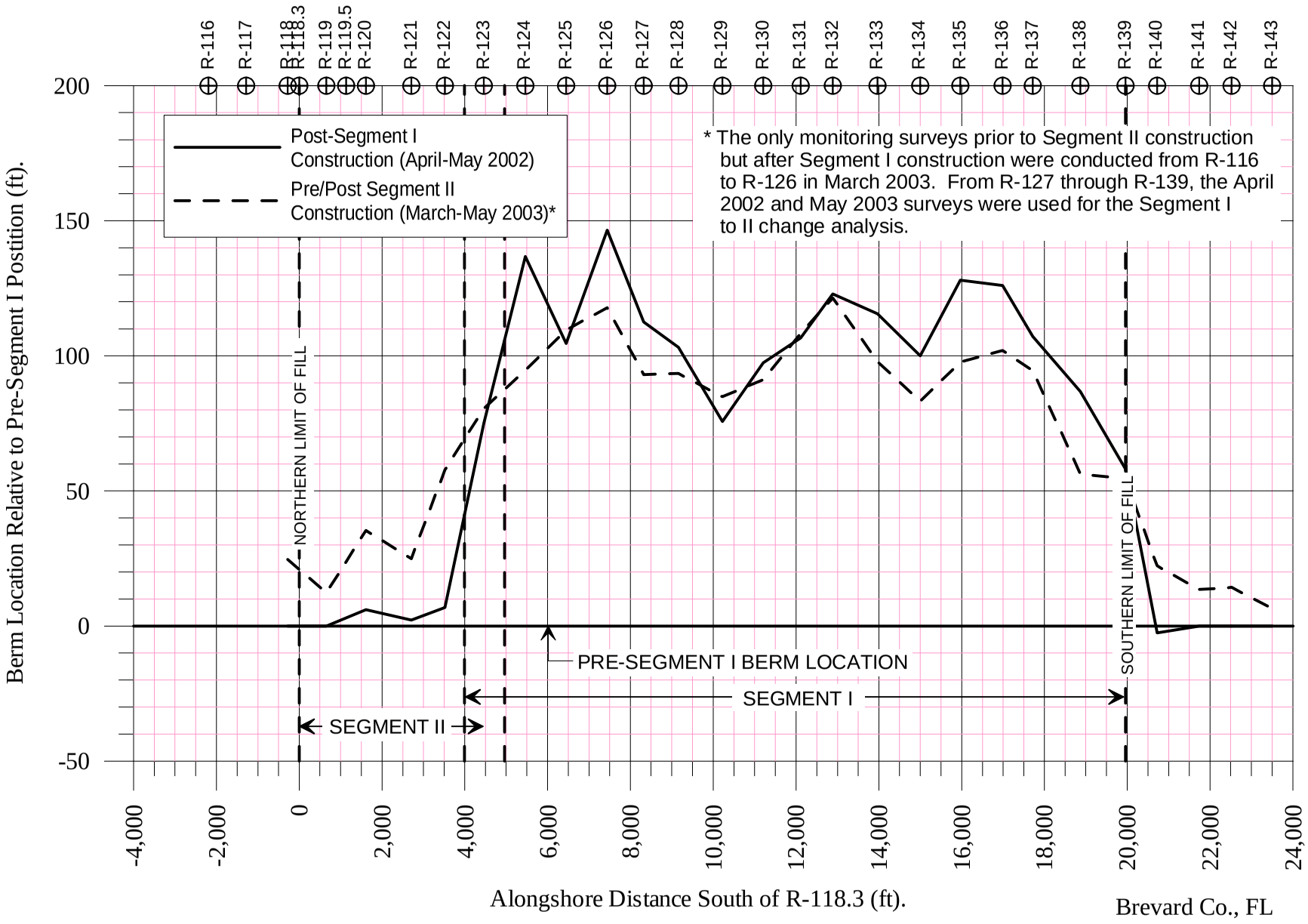

Figure 6.7: Location of the edge of the **"dry berm"** (+7.6-ft NGVD) relative to the pre-Segment I construction location (January-April 2002).

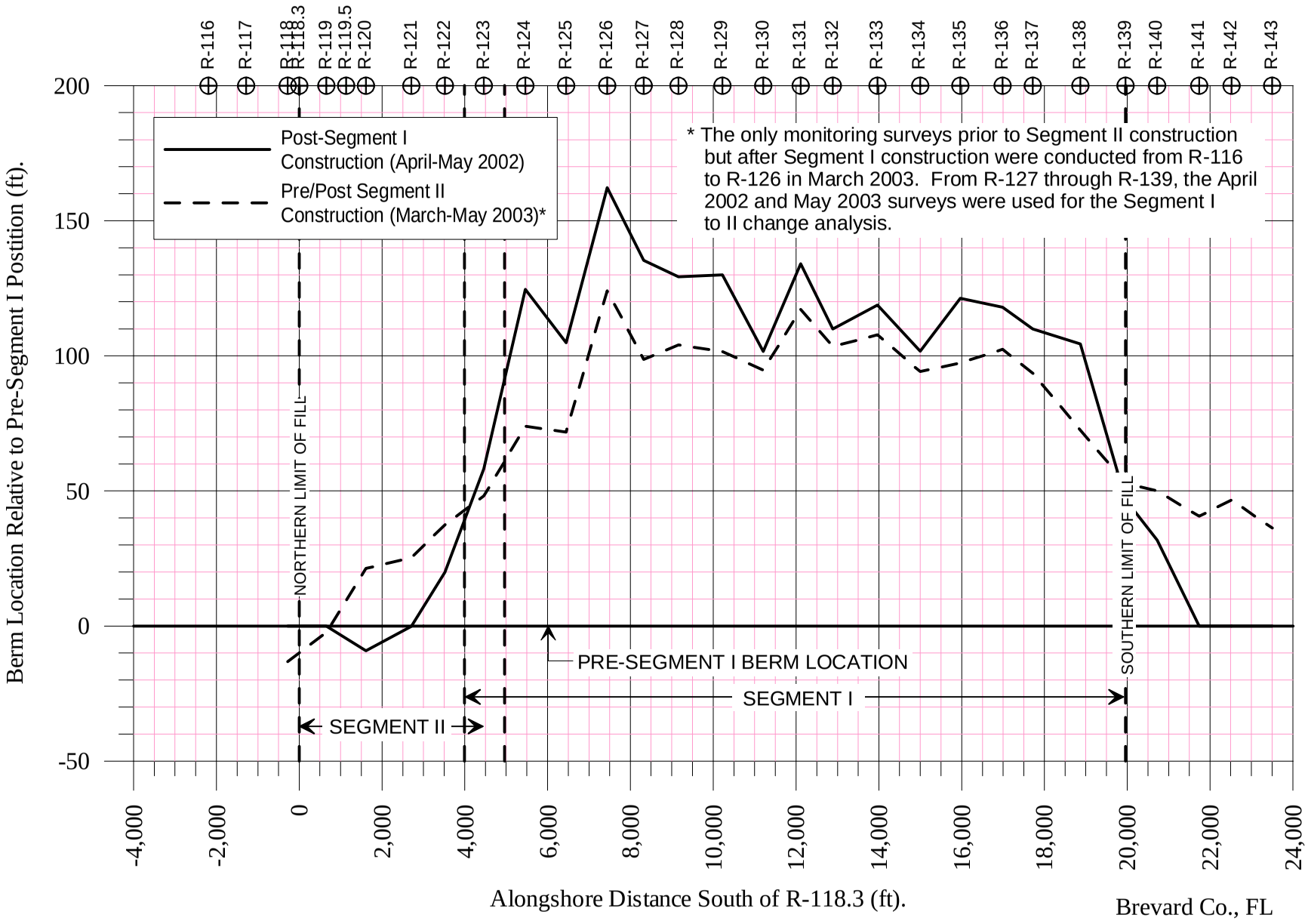

Figure 6.8: Location of the edge of the **"mean high water line"** (+2.0-ft NGVD) relative to the pre-Segment I construction location (January-April 2002).

- The beach north of the Segment I fill area (R-118 to R-122.5) exhibited net gains of +36,500 cy above -16 ft-NGVD and +24,700 above MHW. The berm and MHWL width increased by +28.0 ft and +11.6 ft, respectively.

- The net overall beach volume changes along the surveyed shoreline (R-118 to R-143), during the approximate one-year interval between Segment I and II construction, was a net loss of -7,500 cy above -16 ft-NGVD and a net gain of +6,000 cy above MHW. These represent almost negligible net change (<1 % of placed volume).

Table 6.5: Change of the location of the "dry-berm" (+7.6 ft-NGVD) and MHWL (+2.0 ft-NGVD) between Segment I and Segment II construction (dates vary).

Reach	Mon.	Distance South of R-118.3	Start Date	End Date	Pre to Post Change (FT)	
					Berm (+7.6 FT-NGVD)	MHWL (+2.0 FT-NGVD)
No Fill (Segment I)	R-118	-280	05/02	03/03	24.6	-13.2
	R-119	660	05/02	03/03	12.3	-2.3
	R-120	1,610	05/02	03/03	29.4	30.5
	R-121	2,710	05/02	03/03	22.7	25.4
Taper	R-122	3,520	05/02	03/03	51.0	17.6
	R-123	4,460	05/02	03/03	5.5	-10.1
Segment I Fill	R-124	5,460	05/02	03/03	-42.2	-50.7
	R-125	6,450	05/02	03/03	5.0	-33.1
	R-126	7,440	05/02	03/03	-28.7	-38.2
	R-127	8,320	04/02	05/03	-19.4	-36.6
	R-128	9,160	04/02	05/03	-9.6	-25.3
	R-129	10,220	04/02	05/03	9.2	-28.4
	R-130	11,210	04/02	05/03	-6.2	-6.9
	R-131	12,110	04/02	05/03	1.7	-16.9
	R-132	12,890	04/02	05/03	-1.5	-6.5
	R-133	13,970	04/02	05/03	-17.8	-11.0
	R-134	15,000	04/02	05/03	-16.8	-7.5
	R-135	15,970	04/02	05/03	-30.3	-23.9
	R-136	16,990	04/02	05/03	-24.0	-15.6
	R-137	17,720	04/02	05/03	-12.7	-16.5
Taper	R-138	18,870	04/02	05/03	-30.5	-31.9
	R-139	19,960	04/02	05/03	-3.6	6.1
No Fill	R-140	20,720	04/02	05/03	24.9	18.2
	R-141	21,740	04/02	05/03	13.5	40.6
	R-142	22,520	04/02	05/03	14.3	46.7
	R-143	23,500	04/02	05/03	6.5	36.3

6.2 Overall Project Monitoring : Pre- to Post-Construction

As stated in Section 6.1, for long-term physical beach monitoring of the entire South Reach project (including subsequent monitoring reports), the pre-construction survey is designated as the portions of the January, April and May 2002 surveys that were conducted most immediately prior to all South Reach project beach fill construction at a given monument as noted in Chapter 4. The post-construction survey for long-term monitoring is designated as the May 2003 monitoring survey.

Project Area. The pre- to post-construction volume changes along the monitored shoreline (R-116 to R-143) are tabulated in **Table 6.6** and presented graphically as **Figure 6.9**. Within the project area (R-118.3 to R-139) the shoreline gained approximately 1,527,600 cy above -16 ft-NGVD. This is similar to the USACE pay volume of 1,521,370 cy. Similarly, the Berm and MHWL advanced by 100.9 and 103.5 ft (including tapers), respectively as a direct result of beach fill construction (**Figure 6.10** and **6.11**).

North and South of the Project Area. North of the project (R-116 to R-118), the 1,910 ft of shoreline lost approximately 2,500 cy (above -16 ft-NGVD) between March 2003 and May 2003[23]. However, above the MHWL (+2.0 ft-NGVD) the shoreline gained approximately 2,300 cy, almost entirely attributable to sand placed at R-118 as part of the north taper of beach fill project. Similarly, the MHWL advanced, on average, by 20.7 ft, while the berm (+7.6 ft-NGVD) retreated by an average of 10.4 ft.

South of the project (R-139 to R-143) the 3,540 ft of shoreline gained approximately 42,800 cy between April 2002 and May 2003. Similarly, the berm and MHWL advanced by 11.1 and 29.6 ft, respectively as sand migrated south from the fill area.

[23] The only surveys conducted at R-116 and R-117 as part of the South Reach monitoring during construction were the March 2003 and May 2003 surveys. Future monitoring surveys will span from R-116 to R-143.

Table 6.6: Pre- to post-construction volume change along monitored shoreline (R-116 to R-143) based upon monitoring surveys

Mon.	Reach (FT)	Pre Date	Post Date	Volume Change (CY) Above Given Elevation +8.6	+2.0	-1.9	-6.0	-16.0
R-116		03/03	05/03					
	910			-100	-1,100	+800	-900	-3,500
R-117		03/03	05/03					
	1000			-400	+1,800	+8,200	+5,400	-900
R-118		05/02	05/03					
	280			-200	+1,600	+4,500	+4,400	+1,900
R-118.3				**Northern Limit of Fill**				
	660			+1,300	+12,900	+21,500	+23,200	+19,100
R-119		05/02	05/03					
	950			+5,200	+33,000	+49,600	+60,800	+61,900
R-120		04/02	05/03					
	1100			+8,000	+41,700	+60,500	+80,400	+77,800
R-121		04/02	05/03					
	810			+6,300	+32,100	+44,200	+59,600	+60,000
R-122		04/02	05/03					
	940			+7,500	+37,300	+51,600	+72,100	+88,800
R-123		04/02	05/03					
	1000			+8,700	+39,800	+56,400	+79,000	+97,300
R-124		04/02	05/03					
	990			+7,100	+34,000	+48,500	+66,400	+81,700
R-125		04/02	05/03					
	990			+4,700	+29,600	+43,800	+56,400	+70,800
R-126		04/02	05/03					
	880			+3,500	+25,800	+39,600	+52,000	+70,700
R-127		01/02	05/03					
	840			+2,500	+22,600	+35,100	+51,100	+71,600
R-128		01/02	05/03					
	1060			+1,800	+26,700	+42,900	+63,700	+84,600
R-129		01/02	05/03					
	990			+1,700	+23,500	+38,100	+55,300	+69,300
R-130		01/02	05/03					
	900			+2,400	+24,500	+38,900	+55,600	+70,100
R-131		01/02	05/03					
	780			+1,700	+23,200	+36,700	+53,200	+70,200
R-132		01/02	05/03					
	1080			+2,400	+30,500	+48,700	+71,300	+91,000
R-133		01/02	05/03					
	1030			+3,100	+27,200	+42,800	+59,700	+74,600
R-134		01/02	05/03					
	970			+3,500	+25,800	+39,500	+55,700	+69,900
R-135		01/02	05/03					
	1020			+5,800	+30,000	+45,600	+67,400	+86,200
R-136		01/02	05/03					
	730			+3,400	+20,800	+31,400	+47,000	+60,100
R-137		01/02	05/03					
	1150			+3,000	+25,400	+40,200	+65,100	+89,100
R-138		01/02	05/03					
	1090			+3,100	+18,200	+29,800	+50,000	+62,800
R-139		01/02	05/03	**Southern Limit of Fill**				
	760			+1,500	+10,300	16,400	+27,400	+27,300
R-140		01/02	05/03					
	1020			+100	+9,400	+15,700	+25,300	+11,400
R-141		04/02	05/03					
	780			-300	+5,700	+9,800	+10,700	-1,700
R-142		04/02	05/03					
	980			-200	+6,500	+9,900	+8,800	+5,800
R-143		04/02	05/03					
Project Area Total (R-118.3 to R-139)				**+86,700**	**+584,600**	**+885,400**	**+1,245,000**	**+1,527,600**
Monitored Area Total (R-116 to R-143)				**+87,100**	**+618,800**	**+950,700**	**+1,326,100**	**+1,567,900**

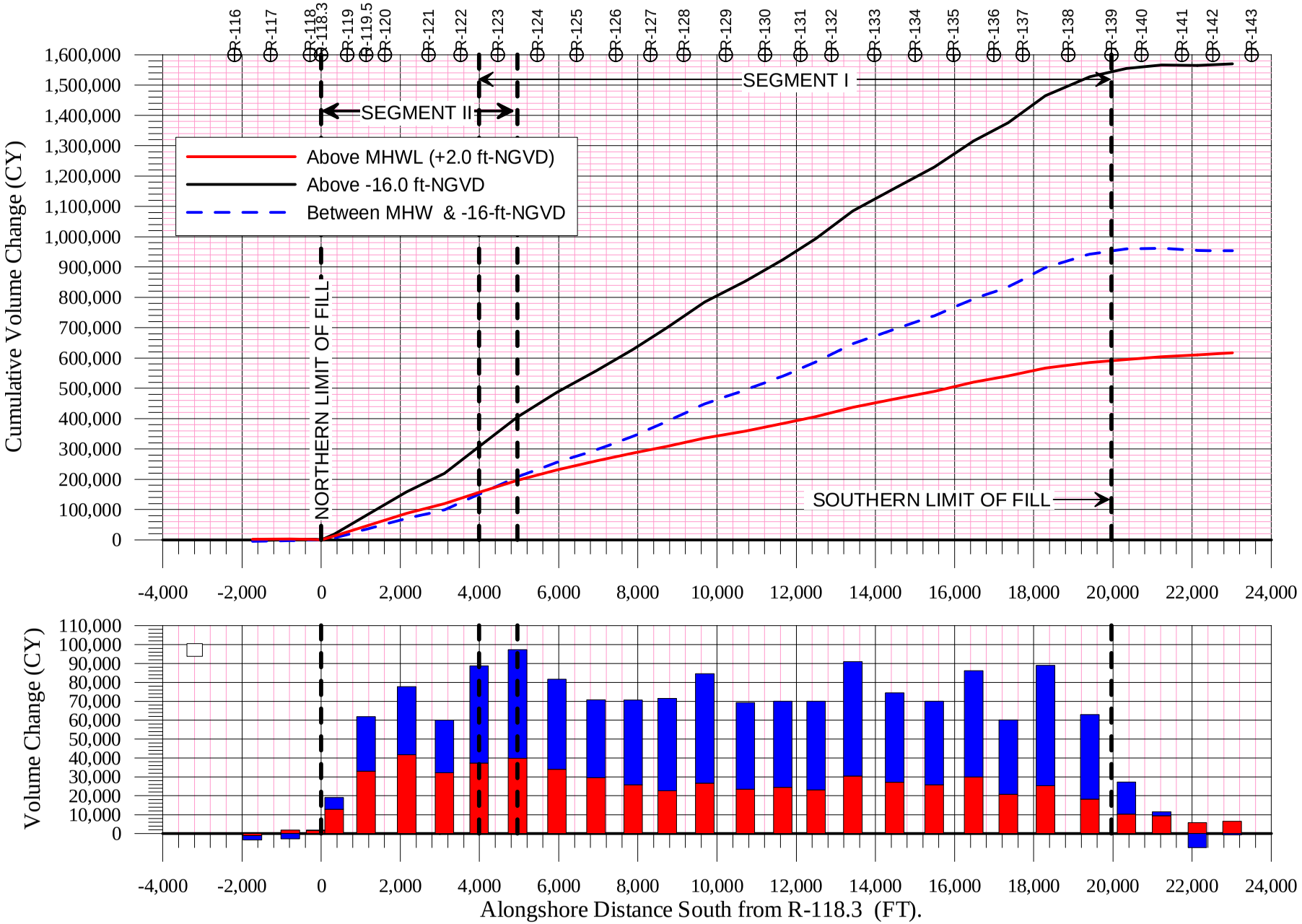

Figure 6.9: Pre- to post-construction volume change along the South Reach Project Area (Pre-Construction to May 2003).

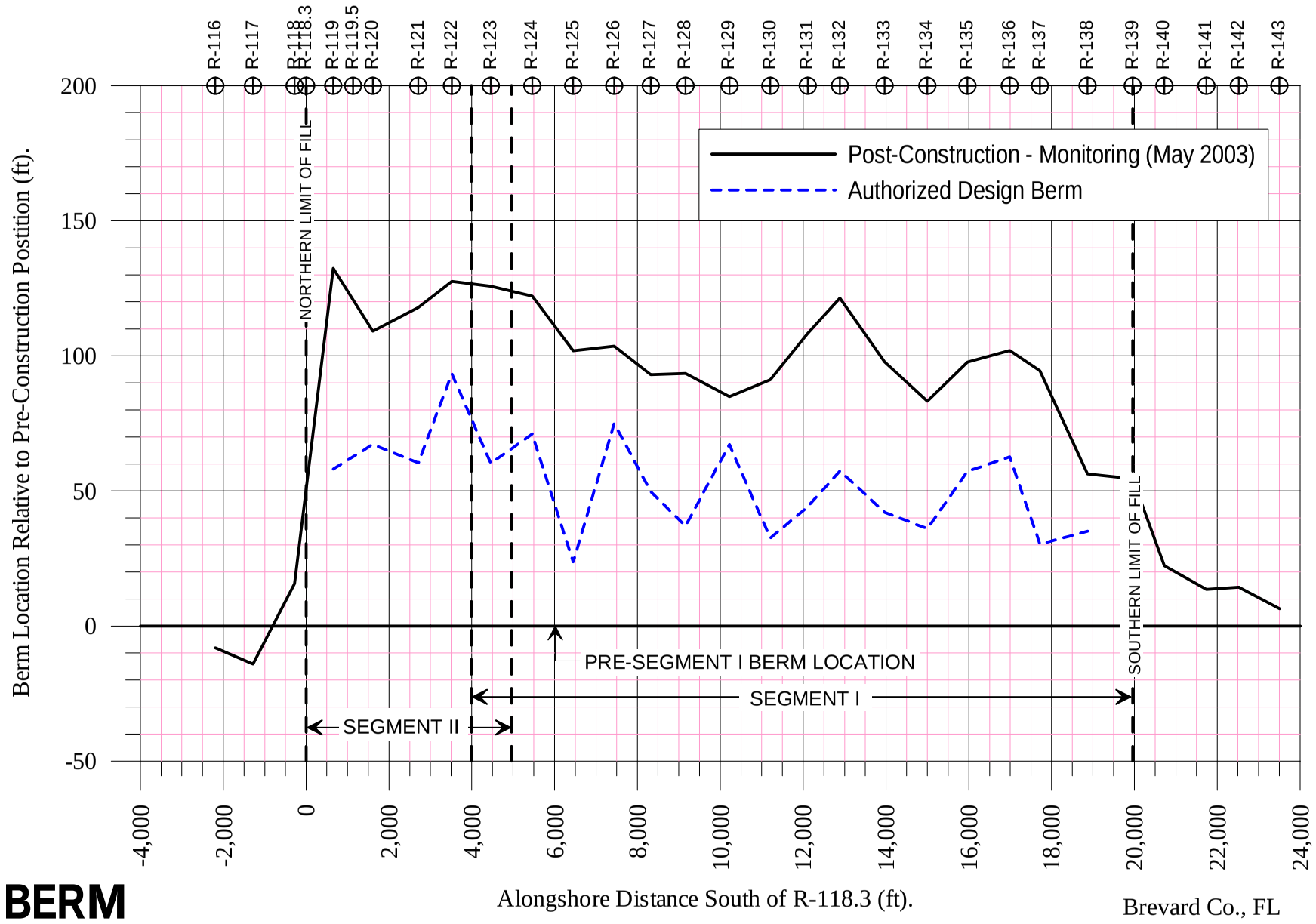

Figure 6.10: Location of the edge of the **"dry berm"** (+7.6-ft NGVD) relative to the pre-construction (monitoring) location (Jan-2002, Apr-2002, May-2002 & March 2003 surveys: see Table 4.1 for **PRE** survey dates).

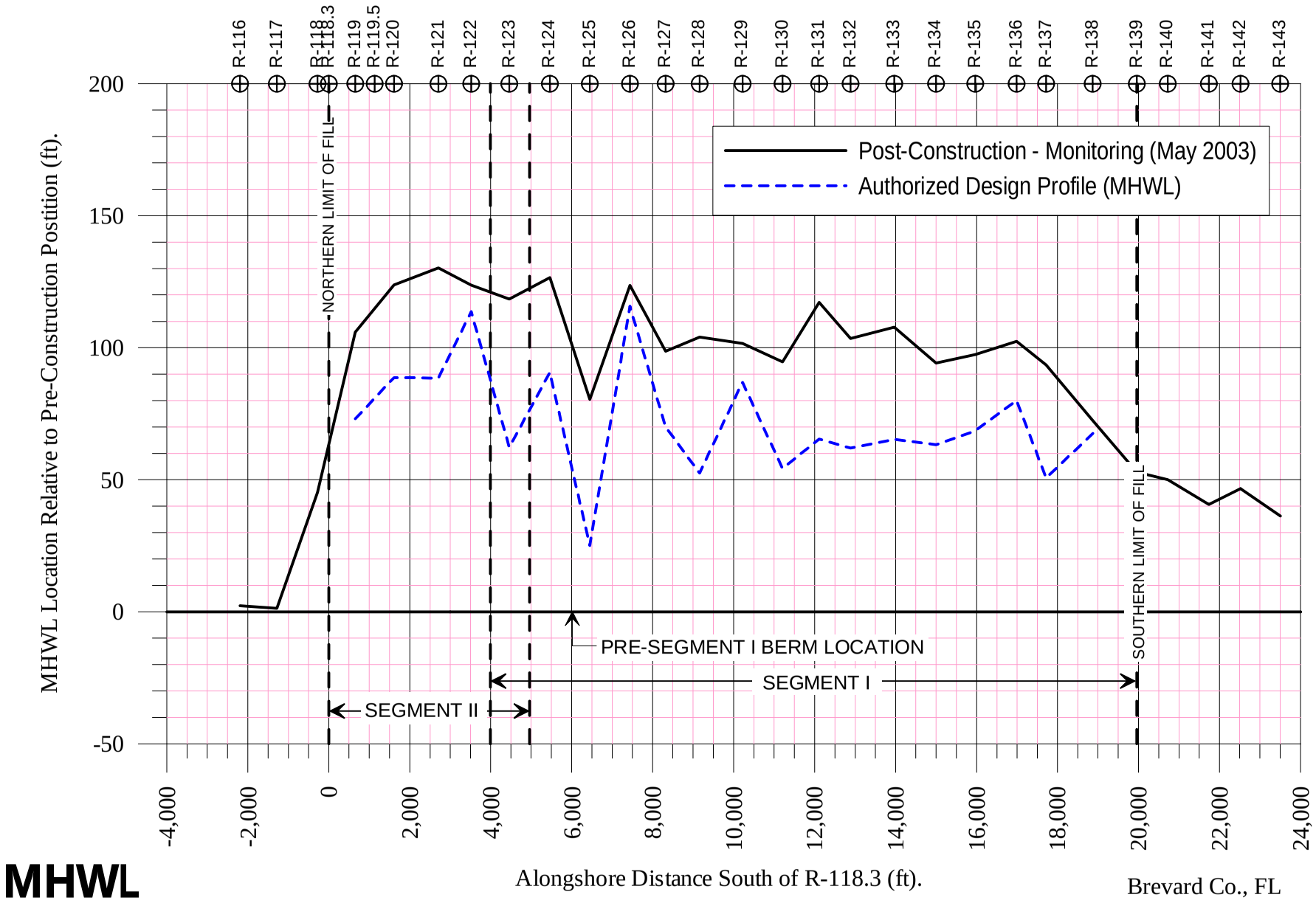

Figure 6.11: Location of the edge of the **mean high water line** (+2.0-ft NGVD) relative to the pre-construction (monitoring) location (Jan-2002, Apr-2002, May-2002 & March 2003 surveys: see Table 4.1 for **PRE** survey dates).

7.0 OFFSHORE BORROW AREA MONITORING

7.1 Overview

This chapter summarizes the dredging activities conducted by Great Lakes Dredge and Dock Company (GLDD) during construction of the South Reach project. The sources of beach fill for the South Reach project were two offshore borrow areas: (1) Space Coast Shoals II (SCS-II) and (2) Canaveral Shoals II (CS-II). The locations of both these borrow sites relative to the project area are shown in **Figure 2.1**. As described in **Chapter 5,** the South Reach project was constructed in two phases: Segment I - between January 2002 and April 15, 2002 and Segment II - between March 28, 2003 and April 26, 2003. Almost all of the sand for the first segment of construction was dredged from the SCS-II site, with a relatively small volume (40,000 – 50,000 cy) dredged from CS-II. For the second segment of construction all of the sand was dredged from CS-II.

Space Coast Shoals II. The SCS-II site is a sandy perturbation, located in federal waters, approximately 13 miles south of Port Canaveral with ambient pre-project elevations between -43.9 and -53.9 ft-NGVD (-42 and -52 ft, MLW). The shoal rises a maximum of 10 to 12 feet above the ambient seabed. Hopper dredging of the 182-acre borrow site commenced on January 14, 2002 and was completed on or about March 31, 2002 (Segment I construction). The Contractor's (GLDD) estimated total dredge production for SCS-II was 1.40 million cubic yards (Mcy). The excavated material was deposited in the South Reach Nearshore Disposal and Sand Rehandling Area (SNDSRA) where it was subsequently re-excavated by cutterhead dredge for the purpose of beach construction (March 13 – April 23, 2002). SCS-II was not used for Segment II construction.

Canaveral Shoals II. The CS-II site is located approximately 8.5 miles due east of Port Canaveral in federal waters. The ambient pre-project seabed elevations ranged between -11.9 to -41.9 ft-NGVD (-10 to -40 ft, MLW). The permitted dredge limits of CS-II encompass approximately 1,200 acres of the more than 20,000 acres of dynamic sand shoals that stem southeastward off Cape Canaveral.

Between December 2000 and May 2003, an estimated 5.2 Mcy of sand were dredged from within the CS-II borrow area. The sand was utilized for initial construction of the Brevard County Federal Shore Protection Project (North and South Reach) and along Patrick Air Force Base, Florida. Bathymetric changes within CS-II resulting from dredging associated with the construction of the North Reach (Oct-2001 to April-2001) and PAFB (Dec-2000 to April-2001) beach fill projects have been previously analyzed (Olsen Associates, Inc. 2001).

During Segment I construction of the South Reach (January-March 2002), the Contractor estimated the total volume excavated from the CS-II site at between 40,000 and 50,000 cy. The excavated material was deposited in the SNDSRA where it was subsequently re-excavated by cutterhead dredge for the purpose of beach construction (March 13 – April 23, 2002). During Segment II construction (March-April 2003), the contractor estimated that approximately 384,000 cy of sand were excavated from the CS-II site. The material was subsequently placed directly onto the South Reach project beach via direct hopper dredge pump-out.

Use of the dredged material from CS-II for construction of the Brevard County Federal Shore Protection Project was in accordance with the U.S Department of Interior, Minerals Management Service (MMS), Lease No. OCS-A-0454 with Brevard County, Florida.

Space Coast Shoals I. A potential borrow area termed "Space Coast Shoals I" (SCS-I) was initially developed north of the Space Coast Shoals II borrow area utilized for the initial 2002 South Reach construction. The SCS-I site was the subject of three vibracoring investigations and two sub-bottom seismic surveys conducted between 1989 and 2000. The site's geotechnical data suggested that there was a likelihood of significant overburden of non-beach compatible material (shell and clay), and the overall strata may be characterized by seams of clay and/or shell. Accordingly, a test excavation through the site was conducted on November 13th, 2000 using a hopper dredge employed for the construction of the South Reach project segment. The test revealed abundant non-suitable material and a decision was made to abandon the Space Coast Shoals I site.

Subsequently detailed geotechnical investigation focused on Space Coast Shoals II. This site was developed through core borings and sub-bottom seismic investigation in November-December, 2000. A hopper-dredge test excavation was conducted through the SCS-II site on January 9th, 2001 and confirmed at least the surficial presence of beach-compatible material. This borrow area was subsequently permitted and ultimately utilized for the majority share of initial construction of the South Reach project. It was depleted of beach-compatible sand after the first segment of construction in Spring 2002.

The area's bathymetry and reconnaissance-level core borings suggest that there may perhaps be one more small deposit of potentially beach-compatible material to the south of SCS-II. It is very likely, however, that any such area would be of irregular strata, with significant content of large shell and clay seams. Future development of an additional sand borrow area in the vicinity of Space Coast Shoals is neither anticipated nor recommended at this time. There is no beach compatible material remaining within the SCS-II site.

7.2 Survey Data

Volumetric changes within SCS-II and CS-II were computed by comparing pre- and post-construction bathymetric surveys of the borrow area. The survey data were collected by the dredge contractor, Great Lakes Dredge & Dock Company, and are summarized in **Table 7.1**.

Table 7.1: Borrow area survey dates.

Survey	Space Coast Shoals II (SCS-II)	Canaveral Shoals II (CS-II)	
	Segment I		Segment II
Pre-Dredge	1/10/2002	1/2002	3/23/2003
Post-Dredge	4/11/2002	4/15/2002	5/2/2003

7.3 Monitoring Results

Space Coast Shoals II - Segment I. The pre- to post-construction survey data indicate that approximately 1.32 Mcy of sediment were dredged from within the permitted limits of Space Coast Shoals II. Analysis of the net volumetric change within the entire survey area suggests a net total change (loss) of approximately 1.41 Mcy following excavation. This agrees with the Contractor's estimated total dredge production for SCS-II of 1.40 Mcy.

Inspection of the onshore beach profiles in the vicinity of the SCS-II (R-065 to R-077) indicated no adverse impact from the SCS-II site on the adjacent beach. A detailed examination of this stretch of shoreline is located in Olsen (2003b).

Canaveral Shoals II – Segment I. Contractor estimates place the total volume excavated from CS-II for Segment I construction between 40,000 and 50,000 cy. When compared to the natural background changes at this borrow area, this dredge quantity is too small to yield a signal which may be reliably attributed to project construction. The data indicate that during this monitoring period, the surveyed area experienced a net gain of approximately 254,000 cy (+373,000 cy gain and -119,000 cy loss), despite the excavation of 40,000 to 50,000 cy by dredging.

Canaveral Shoals II – Segment II. The Contractor reported that dredging activity was limited to the southern portion of CS-II specifically along the southeastern edge of the permitted borrow area limits. The extent of the 2003 dredging operation (about 161 acres) is relatively small compared with the overall borrow area, which covers about 1,200-acres. The data indicate a gross decrease (loss) of approximately 287,500 cy

of sand over the March-May 2003 period within the area of interest. This computed volume is smaller than the final haul volume estimate provided by the Contractor (384,081) and smaller than the pay volume computed by the U.S. Army Corps of Engineers (324,686 cy). A detailed discussion of the CS-II monitoring data is provided in **Appendix E.**

8.0 NEARSHORE DISPOSAL AND SAND REHANDLING AREA (SNDSRA)

8.1 Overview

This chapter summarizes the construction and use of the Nearshore Disposal and Sand Rehandling Area (SNDSRA) used as a staging area for sand placement onto the beach for construction of the Brevard County South Reach beach fill. The SNDSRA was only used during construction of Segment I (R-122 to R-139) in January-April 2002.. Segment II was constructed by direct hopper dredge pump-out.

The permitted construction limits encompassed an approximately 250 acre rectangular area with ambient pre-project depths of about –37.9 ft to –44.9 ft NGVD, (or about –36.0 to -43.0 ft MLW). The maximum sand stockpile elevation allowed within the SNDSRA was -22.9 ft NGVD (-21.0 ft MLW). The project permits and USACE specifications required that a minimum 2-ft thickness, or "buffer", of dredged sand be placed and maintained above the ambient seabed – as the ambient sediments were composed of non beach-compatible material. The landward boundary of the SNDSRA was located about 3,000 ft from the mean high water line. Its dimensions were 2,500 ft cross-shore by 4,500 ft alongshore. The location of the SNDSRA relative to the project shoreline is illustrated in **Figures 2.1**, **3.1** and **5.2** (previous sections).

By FDEP permit, use of the rehandling area is permitted from October 1 through April 30, although placement of fill material from the rehandling area onto the beach is permitted only from November 1 through April 30. The federal (NEPA) documents allow year-round use of the rehandling area, with beach fill operations limited to November 1 through April 30.

8.2 Survey Data

Volumetric changes within the SNDSRA during construction of the South Reach project were computed through comparison of the following surveys.

- Pre-construction (January 10, 2002)
- 45-day interim survey (February 26, 2002)
- Post-construction (April 23, 2002)

The survey data were collected by the dredge contractor, Great Lakes Dredge & Dock Company.

8.3 Monitoring Results

Dredging and disposal to the SNDRA began January 13, 2002 and was completed April 18, 2002. Based upon pre- and post-construction surveys approximately 1.45 million cubic yards (Mcy) of sand were placed within the SNDSRA. All of this material was from the Space Coast Shoals II borrow area except for approximately 0.05 Mcy cut from Canaveral Shoals II. Of this volume, between 1.20 and 1.24 Mcy of fill were placed onto the Segment I shoreline between March 12 and April 24, 2002. As of the final monitoring survey (April 23, 2002) between 200,000 and 252,000 cy of placed sand remains within the SNDSRA. A detailed discussion of the monitoring data and results is presented in **Appendix F**.

9.0 BEACH FILL SEDIMENTS

9.1 Sediment Data

A total of 42 physical samples of the placed fill material were collected from the construction berm and analyzed for grain size distribution. Additionally, 6 samples were analyzed for carbonate composition by high-temperature burn. The sand samples were collected in May 2002 and May 2003 along the landward- and mid-berm locations of each of 21 alongshore sites, at depths of approximately 12 inches below the surface of the fill. The landward berm samples were typically collected 5 to 20 feet seaward of the project's dune feature in order to exclude native beach material. Of the 21 alongshore sample locations, 17 were from the beach fill completed in April 2002 and represent material primarily from SCS-II, which was rehandled by cutter-head dredge. The other 4 alongshore sample locations were in the beach fill completed in April 2003 and represent material from CS-II placed by direct pump-out. All of the samples were collected within about 30 to 45 days after the beach fill was constructed.

Ellis & Associates, Inc. (Jacksonville, FL) performed the grain size analyses and visual estimates of shell content and S.E.A. Inc. (Melbourne, FL) performed the high-temperature carbonate burn tests.

9.2 Discussion

A detailed discussion of the sediment data results is present as **Appendix G**. Overall, the in-place material is slightly coarser than that of the SCS-II borrow area composite primarily due to either the anticipated loss of fines associated with hopper dredging and the possible excavation of reposed sands surrounding the borrow area. There was little variation between the CS-II borrow area composite and the in-place fill. Small variations exist and are due to geologic variations within the CS-II borrow area which are observable due to the limited extent of South Reach dredging in CS-II.

There are no significant alongshore differences in the grain size composition of the placed material, excepting a weak indication of higher fractions of bulk coarse material (>1mm) south of R-131. The landward berm material is slightly finer than the mid-berm material, on average, but this may be due to expected sampling variations. The northernmost end of the initial, 2002 construction berm may include some material dredged from Canaveral Shoals II; however, this represented a small fraction of the fill material (<50,000 cy). The grain size distributions of the SCS-II and CS-II fill material are very similar, except that the SCS-II material has approximately 5% greater coarse fraction at the 1.0 mm size.

10.0 WATER QUALITY (TURBIDITY) DATA

10.1 Data

Per FDEP water quality permit conditions, turbidity was measured every 6 hours during construction activity at the borrow area, rehandling area (disposal and dredging), and beach fill sites. Due to safety concerns, measurements were only required during daylight-hours. Background turbidity was measured 500 meters upcurrent from the activity and compliance turbidity was measured not more than 150 meters downcurrent from the activity in the densest portion of the visible plume. The maximum permitted turbidity was 29 NTU above background.

Tables 10.1 and **10.2** summarize the turbidity data collected during Segment I and Segment II construction, respectively. Values for the "difference" between compliance (construction) and background measurements were set to zero in those cases where the measured compliance value was actually less than the background value.

10.2 Discussion

Segment I. Overall, turbidity averaged about 4.3 NTU above background near the water surface and 4.8 NTU above background near the seabed. None of the turbidity measurements exceeded the 29 NTU maximum. There was no significant difference in measured turbidity between the dredging, rehandling and beach fill activities. Activity at the rehandling area – both disposal and dredging, resulted in slightly lower turbidity than that observed at the borrow area and beach fill areas.

Segment II. Overall, the turbidity averaged about 3.7 NTU above background near the water surface and 4.1 NTU above background near the seabed. None of the turbidity measurements exceeded the 29 NTU maximum. There was no significant difference in measured turbidity between the dredging and beach fill activities (the SNDSRA was not used during Segment II construction).

Overall. The typical construction-related turbidity of all aspects of both segments was minimal. None of the turbidity measurements exceeded the 29 NTU maximum. The maximum observed value was 23.3 NTU at the Space Coast Shoals II borrow area during Segment I construction.

Background (ambient) turbidity at the SNDRA and offshore borrow area averaged about 2 to 3 NTU near the surface and 3 to 4 NTU near the seabed with maximum values between about 4 to 18 NTU. Ambient turbidity at these sites likely reach much greater values during elevated seas. The measurements reported herein were limited to smaller sea states (2 to 5 ft) in which the monitoring vessel could safely work. Background turbidity at the beach fill sites was greater – averaging about 8.0 NTU and 9.5 NTU at the surface and near-seabed, respectively.

Table 10.1: Segment I construction turbidity monitoring data.

	Surface Measurement (NTU)			Seabed +1 meter (NTU)		
	Compliance	**Background**	**Difference**	**Compliance**	**Background**	**Difference**
Beach Fill						
AVG	15.0	7.5	**7.5**	17.8	9.1	**8.8**
STD	6.6	4.2	**4.7**	6.6	5.1	**4.7**
MIN	3.2	1.4	**0.4**	6.1	2.5	**0.0**
MAX	26.9	17.6	**18.0**	28.9	21.8	**17.2**
Space Coast Shoals II Borrow Area						
AVG	6.7	2.3	**4.4**	7.6	3.2	**4.5**
STD	4.0	1.9	**3.4**	4.4	2.3	**4.2**
MIN	0.3	0.1	**0.0**	1.1	0.4	**0.0**
MAX	20.0	9.3	**18.0**	25.4	12.8	**23.3**
Canaveral Shoals II Borrow Area						
AVG	7.4	2.3	**5.2**	8.6	3.5	**5.1**
STD	4.1	0.9	**4.6**	4.3	3.4	**6.4**
MIN	3.1	0.7	**0.4**	3.4	1.8	**0.0**
MAX	14.5	3.8	**12.7**	14.5	14.2	**12.2**
Rehandling Area (SNDRA) – Disposal and Dredging						
AVG	5.6	2.3	**3.3**	6.9	2.9	**4.0**
STD	3.5	1.6	**3.1**	4.3	2.0	**4.2**
MIN	0.4	0.1	**0.0**	0.8	0.1	**0.0**
MAX	17.6	7.9	**13.1**	21.1	16.0	**18.0**
Summary (All Segment I Datapoints)						
AVG	7.3	3.0	**4.3**	8.7	3.8	**4.8**
STD	5.3	2.9	**3.8**	6.0	3.5	**4.6**
MIN	0.3	0.1	**0.0**	0.8	0.1	**0.0**
MAX	26.9	17.6	**18.0**	28.9	21.8	**23.3**

Table 10.2: Segment II construction turbidity monitoring data.

	Surface Measurement (NTU)			Seabed +1 meter (NTU)		
	Compliance	**Background**	**Difference**	**Compliance**	**Background**	**Difference**
Beach Fill						
AVG	12.0	8.5	**3.5**	13.5	9.9	**3.7**
STD	8.4	6.5	**3.2**	8.5	6.6	**3.4**
MIN	2.4	1.3	**0.1**	3.3	2.8	**0.0**
MAX	36.4	22.2	**14.9**	37.0	22.7	**16.9**
Canaveral Shoals II Borrow Area						
AVG	6.6	2.5	**4.1**	8.4	3.5	**4.9**
STD	3.9	1.1	**3.9**	3.9	1.5	**4.0**
MIN	2.1	0.6	**0.1**	3.6	1.3	**0.4**
MAX	18.5	5.2	**17.3**	19.7	7.0	**17.3**
Summary (All Segment II Datapoints)						
AVG	9.9	6.2	**3.7**	11.5	7.4	**4.1**
STD	7.5	5.9	**3.5**	7.5	6.1	**3.7**
MIN	2.1	0.6	**0.1**	3.3	1.3	**0.0**
MAX	36.4	22.2	**17.3**	37.0	22.7	**17.3**

11.0 ENDANGERED SPECIES OBSERVATIONS

11.1 Dredging

No incidents or unusual activities were reported at either the Canaveral Shoals II or Space Coast Shoals II borrow areas or at the rehandling area during either disposal or dredging.

11.2 Beach Fill

Data describing turtle nesting success following construction of the South Reach project are not included in this report. Early-season daily monitoring for marine turtle nesting activity was performed in 2002 and 2003 by Geomar, Inc. Daily monitoring for nesting activity and related investigations during the main nesting seasons of 2002 and 2003 were performed by Dr. Llew Ehrhart and the University of Central Florida.

12.0 SUMMARY

Initial construction of the Brevard County, FL Federal Shore Protection Project, South Reach (a/k/a Phase Two) involved the placement of approximately 1.6 million cubic yards (Mcy) of beach nourishment sand along approximately 3.8 miles of the Brevard County Atlantic Ocean shoreline between FDEP Monument R-118.3 and R-139. The project was constructed in two segments to comply with permit conditions that restrict beach fill placement during marine turtle nesting season. Segment I (R-122.5 to R-139) was constructed from February 2002 through April 2002. Segment II (R-118.3 to R-123.5) was constructed in March/April 2003. The pay (template) volume was 1,504,005 cy.

On average, the initial project construction resulted in a 110-ft wide construction berm and a 120-ft advance of the mean high water line (MHWL). The recreational beach area was increased from 31.1 acres to 83.7 acres. This represents an increase of about 52.6 acres or 269.1 percent.

The total placed volume (R-118.3 to R-139) was 1,462,400 cy above -16 ft-NGVD, based upon the Segment I and II pre- to post-construction profile surveys. Of this quantity, 602,900 cy were placed above MHW. The contractor's total estimated placement was 1,514,081 cy.

Two offshore sand sources were used for beach fill construction: Space Coast Shoals II (SCS-II) and Canaveral Shoals II (CS-II). Almost all of the sand for the first segment of construction was dredged from the SCS-II site, with a relatively small volume (40,000 – 50,000 cy) dredged from CS-II. For the second segment of construction all of the sand was dredged from CS-II. The South Reach Nearshore Disposal and Sand Rehandling Area (SNDSRA) was used as a temporary staging area for fill material before direct placement onto the South Reach Project Area. The SNDSRA was only used during construction of Segment I. Direct hopper dredge pump-out from CS-II was used for construction of Segment II.

The beach fill was placed hydraulically in the form of a 90 to 125 ft construction berm. The berm was constructed at +10 ft-MLW (+8.1 ft-NGVD) from R-125.0 to R-134.9. From R-123.5 to R-125.0 and R-134.9 to R-139.0 the berm elevation was 10.8 ft-MLW (+8.9 ft-NGVD). During Segment II construction, the berm was constructed at a mild seaward slope from +11.5 ft to +10 ft-MLW (+9.6 to +8.1 ft-NGVD) from R-118.3 to approximately R-125. Seaward of the berm, the constructed beach slope was 1:15 along the entire project shoreline. A small dune feature was also constructed.

Pre- and post-construction surveys of the SNDSRA indicate that approximately 200,000 to 252,000 cubic yards remain in the rehandling area as the requisite 2-ft buffer placed atop the ambient seabed. Bathymetric surveys likewise indicate that approximately 1.45 Mcy were dredged from the Space Coast Shoals II offshore borrow site and there is no remaining borrow material in the permitted limits of that site.

Surveys indicate a net change (loss) of about -0.43 Mcy from the Canaveral Shoals II borrow area in the vicinity of South Reach dredging activity. Since dredging of CS-II commenced in October 2000, it is estimated that approximately 5.20 Mcy have been borrowed from the site. The net measured volume change within the limits of CS-II, from October 2000 to April 2003 is approximately -4.95 Mcy, suggesting background gains of about 0.25 Mcy relative to the estimated dredge quantity. To date, no sand has been dredged from the Canaveral Shoals I offshore borrow area.

Approximately one-year elapsed between completion of Segment I and construction of Segment II. During this one-year interlude in construction the filled Segment I shoreline (R-122.5 to R-139) exhibited an overall net loss of -55,000 cy above -16 ft-NGVD, of which -44,600 cy was above MHW. The beach south of the Segment I fill area (R-139 to R-143) exhibited net gains of +11,000 cy above -16 ft-NGVD and +25,900 cy above MHW; and, the beach north of the Segment I fill area (R-118 to R-122.5) exhibited net gains of +36,500 cy above -16 ft-NGVD and +24,700 above MHW. The gains along the adjacent shoreline are mainly the result of a feeder effect from the fill area. The net overall beach volume changes along the surveyed shoreline (R-118 to R-143), during the approximate one-year interval between Segment I and II construction, was a net loss of -7,500 cy above -16 ft-NGVD and a net gain of +6,000 cy above MHW. These represent almost negligible net change (<1 % of placed volume).

As of May 2003, along the full fill shoreline (R-120 to R-138), the berm and MHWL are on average 48.9 ft and 33.8 ft, respectively seaward of the Corps' baseline (authorized design). Along the Segment I full fill (R-125 to R-138) the berm and MHWL are 48.5 ft and 33.2 ft seaward of the Corps' baseline, respectively. Along the Segment II full fill (R-120 to R-124) the berm and MHWL are 50.0 ft and 35.8 ft seaward of the Corps' baseline, respectively.

Construction management of the South Reach project was by the U.S. Army Corps of Engineers, Jacksonville District. The local sponsor and FDEP permittee was Brevard County, FL. The construction contractor was Great Lakes Dredge and Dock. Olsen Associates, Inc. was the coastal engineering consultant to Brevard County.

The final construction cost for the South Reach initial construction (excluding Corps costs and expenditures by the non-federal sponsor) was approximately $ 12.7M±. The total bid value was $13,872,039. The final cost difference resulted from a slightly smaller fill volume than the contract estimate and no requirement for sea turtle trawling/relocation. The federal cost-share was 56.30 %. The County and State cost-share was 21.85 % each.

The federal authorized project is to maintain a sand berm at +10 ft-MLW that extends to the location of the pre-project MHWL. This is the equivalent of an average 70-ft advance of the pre-project MHWL. The U.S. Army Corps of Engineers' (USACE) nominal prediction of renourishment requirements is 601,000 cy in 6-year intervals.

Beach profile monitoring surveys will be repeated at FDEP R-monuments R-116 to R-143 in approximately May, 2004. This will represent the one-year post-construction survey for long-term monitoring purposes.

13.0 REFERENCES

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APPENDIX A:

Measured Beach Profiles

This appendix contains plots of the measured beach profiles from R-116 through R-143, Brevard County, FL. Monument locations are listed in **Table A-1** and are referenced to the Florida State Plane Coordinate System, East Zone, North American Datum of 1983 (NAD83). Elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD29). Survey dates of the measured profiles are summarized in **Tables A-2** and **A-3,** and the profiles are plotted as **Figures A-1** through **A-28**.

Table A.1: Brevard County, Federal Shore Protection Project, South Reach project area FDEP R-Monument locations.

Mon.	Easting (FT-NAD83)	Northing (FT-NAD83)	Elevation (FT-NGVD29)	Azimuth
R-116	1,372,836.96	793,840.46	15.05	80
R-117	1,372,022.77	794,426.70	16.24	80
R-118	1,371,067.88	794,712.33	16.73	80
R-119	1,370,166.10	794,955.12	16.97	80
R-120	1,369,222.42	795,017.60	13.80	80
R-121	1,368,168.19	795,313.28	14.93	80
R-122	1,367,392.32	795,519.98	13.59	80
R-123	1,366,499.22	795,805.95	15.17	80
R-124	1,365,582.42	796,322.14	17.79	80
R-125	1,364,637.09	796,594.94	17.22	80
R-126	1,363,699.80	796,974.98	16.01	80
R-127	1,362,826.84	797,025.77	14.64	80
R-128	1,362,037.14	797,322.19	15.07	80
R-129	1,361,044.51	797,722.96	16.88	80
R-130	1,360,099.05	797,990.72	15.64	80
R-131	1,359,259.92	798,370.30	16.13	80
R-132	1,358,537.10	798,661.32	16.65	80
R-133	1,357,530.11	799,054.92	15.97	80
R-134	1,356,580.47	799,468.30	16.12	80
R-135	1,355,679.54	799,819.26	15.20	80
R-136	1,354,721.36	800,135.22	18.03	80
R-137	1,354,056.50	800,491.33	14.81	80
R-138	1,352,974.70	800,979.06	16.86	70
R-139	1,351,911.50	801,250.98	16.57	70
R-140	1,351,240.54	801,615.57	16.17	70
R-141	1,350,287.78	801,982.99	15.88	70
R-142	1,349,569.28	802,281.48	16.83	70
R-143	1,348,656.08	802,648.39	16.39	70

Table A.2: South Reach monitoring survey summary, Brevard County, FL.

Segment	Mon	Easting (ft-NAD83)	Northing (ft-NAD83)	Monitoring Survey Date[1]				
				Jan. 2002	April 2002	May 2002	Mar/Apr 2003	May 2003
North	R-116	793,840.46	1,372,836.96				**PRE**	**POST**
	R-117	794,426.70	1,372,022.77				**PRE**	**POST**
Segment I	R-118	794,712.33	1,371,067.88			**PRE**	PRE (II)	**POST**
	R-119	794,955.12	1,370,166.10			**PRE**	PRE (II)	**POST**
	R-120	795,017.60	1,369,222.42		**PRE**	POST (I)	PRE (II)	**POST**
	R-121	795,313.28	1,368,168.19		**PRE**	POST (I)	PRE (II)	**POST**
	R-122	795,519.98	1,367,392.32		**PRE**	POST (I)	PRE (II)	**POST**
Segment II	R-123	795,805.95	1,366,499.22		**PRE**	POST (I)	PRE (II)	**POST**
	R-124	796,322.14	1,365,582.42		**PRE**	POST (I)	PRE (II)	**POST**
	R-125	796,594.94	1,364,637.09		**PRE**	POST (I)	PRE (II)	**POST**
	R-126	796,974.98	1,363,699.80		**PRE**	POST (I)	PRE (II)	**POST**
	R-127	797,025.77	1,362,826.84	**PRE**	POST (I)			**POST**
	R-128	797,322.19	1,362,037.14	**PRE**	POST (I)			**POST**
	R-129	797,722.96	1,361,044.51	**PRE**	POST (I)			**POST**
	R-130	797,990.72	1,360,099.05	**PRE**	POST (I)			**POST**
	R-131	798,370.30	1,359,259.92	**PRE**	POST (I)			**POST**
	R-132	798,661.32	1,358,537.10	**PRE**	POST (I)			**POST**
	R-133	799,054.92	1,357,530.11	**PRE**	POST (I)			**POST**
	R-134	799,468.30	1,356,580.47	**PRE**	POST (I)			**POST**
	R-135	799,819.26	1,355,679.54	**PRE**	POST (I)			**POST**
	R-136	800,135.22	1,354,721.36	**PRE**	POST (I)			**POST**
	R-137	800,491.33	1,354,056.50	**PRE**	POST (I)			**POST**
	R-138	800,979.06	1,352,974.70	**PRE**	POST (I)			**POST**
	R-139	801,250.98	1,351,911.50	**PRE**	POST (I)			**POST**
South	R-140	801,615.57	1,351,240.54	**PRE**	POST (I)			**POST**
	R-141	801,982.99	1,350,287.78		**PRE**			**POST**
	R-142	802,281.48	1,349,569.28		**PRE**			**POST**
	R-143	802,648.39	1,348,656.08		**PRE**			**POST**

[1] The pre- and post-construction surveys for monitoring purposes are designated **PRE** and **POST,** respectively. Surveys designated as POST (I) were taken immediately following construction of Segment I but prior to construction of Segment II and have been used in conjunction with the **PRE** surveys to calculate the Segment I construction volumes. Surveys designated as PRE (II) were conducted immediately prior to Segment II construction and have been used in conjunction with the **POST** surveys to calculate the Segment II construction volumes.

Table A.3: South Reach monitoring survey summary, Brevard County, FL.

Mon	Monitoring Survey Date									
	Jan.2002		April 2002		May 2002		Mar/Apr 2003		May 2003	
	Onshore	Offshore	Onshore	Offshore	Onshore	Offshore	Onshore	Offshore	Onshore	Offshore
R-116							3/15	4/4	5/6	5/2
R-117							3/15	4/4	5/6	5/2
R-118					5/13	None	3/14	4/4	5/6	5/2
R-119					5/13	None	3/14	4/4	5/6	5/2
R-120			4/19	4/19	5/13	None	3/14	4/4	5/8	5/2
R-121			4/4	4/19	5/13	None	3/14	4/4	5/8	5/2
R-122			4/4	4/19	5/13	None	3/14	4/4	5/8	5/2
R-123			4/4	4/19	5/13	None	3/14	4/4	5/8	5/2
R-124			4/4	4/19	5/13	None	3/14	4/4	5/8	5/2
R-125			4/4	4/19	5/13	None	3/14	4/4	5/8	5/2
R-126			4/4	4/19	5/13	None	3/14	4/4	5/8	5/2
R-127	1/17	1/10	4/19	4/19					5/14	5/2
R-128	1/17	1/10	4/19	4/19					5/14	5/2
R-129	1/17	1/10	4/19	4/19					5/14	5/2
R-130	1/17	1/10	4/19	4/19					5/8	5/2
R-131	1/17	1/10	4/19	4/19					5/14	5/2
R-132	1/7	1/10	4/17	4/19					5/14	5/2
R-133	1/7	1/10	4/17	4/19					5/14	5/2
R-134	1/7	1/10	4/17	4/19					5/14	5/2
R-135	1/7	1/10	4/17	4/19					5/14	5/2
R-136	1/7	1/10	4/17	4/19					5/14	5/2
R-137	1/7	1/10	4/17	4/19					5/15	5/2
R-138	1/7	1/10	4/18	4/19					5/15	5/2
R-139	1/17	1/10	4/18	4/19					5/15	5/2
R-140	1/17	1/10	4/18	4/19					5/15	5/2
R-141			4/18	4/19					5/15	5/2
R-142			4/18	4/19					5/15	5/2
R-143			4/18	4/19					5/15	5/2

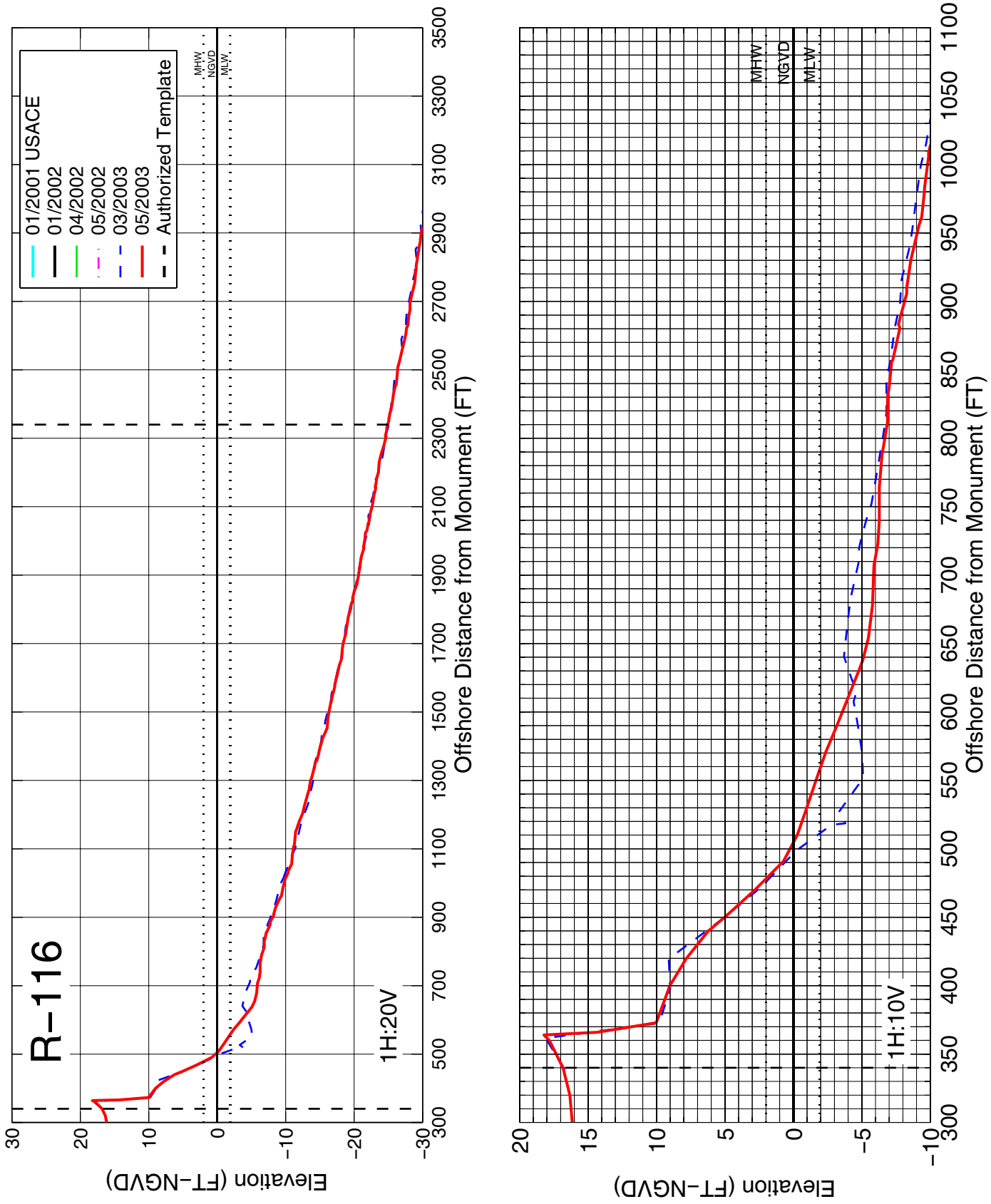


Figure A–01: Measured beach profiles at monument R–116 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

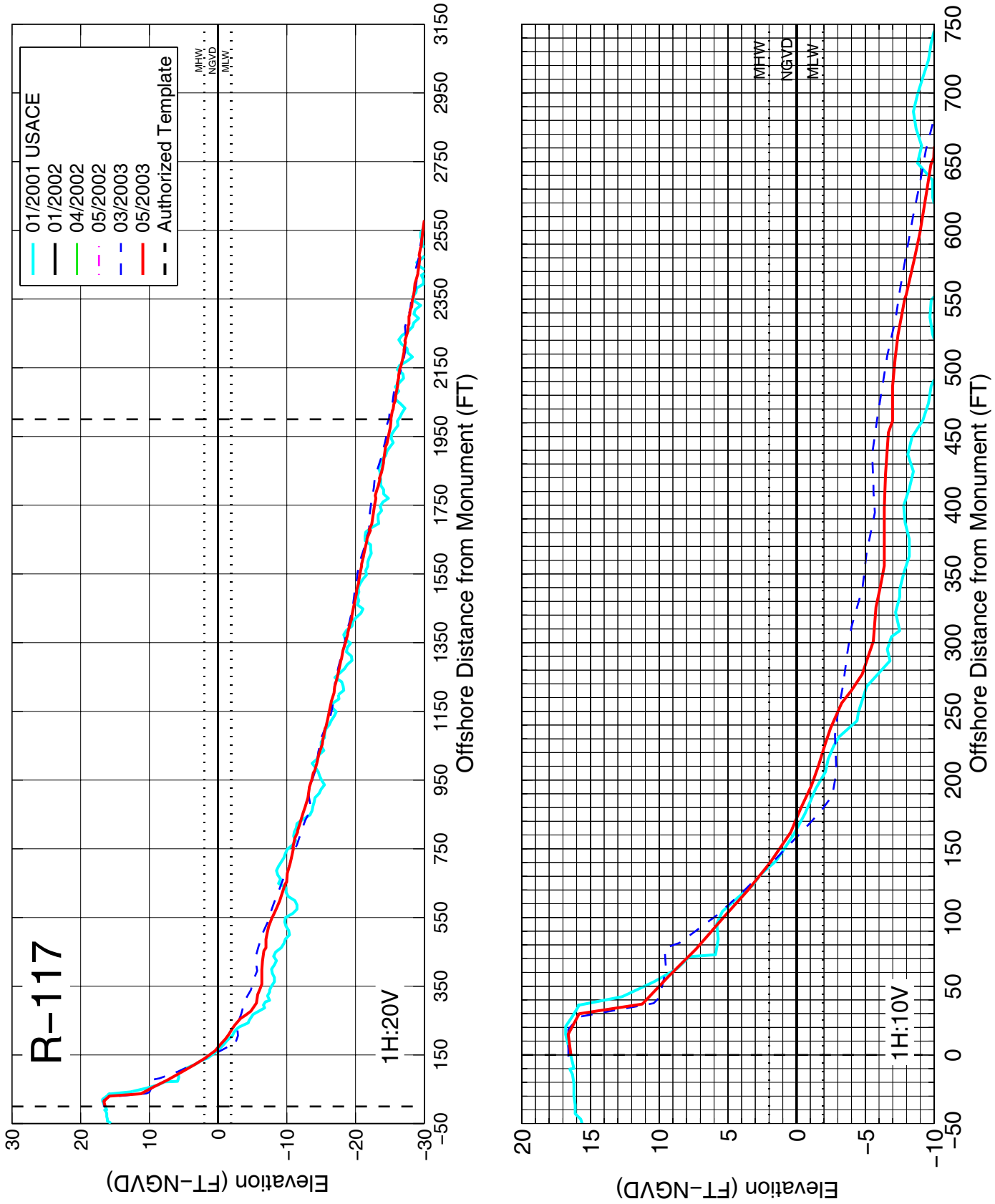


Figure A–02: Measured beach profiles at monument R–117 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

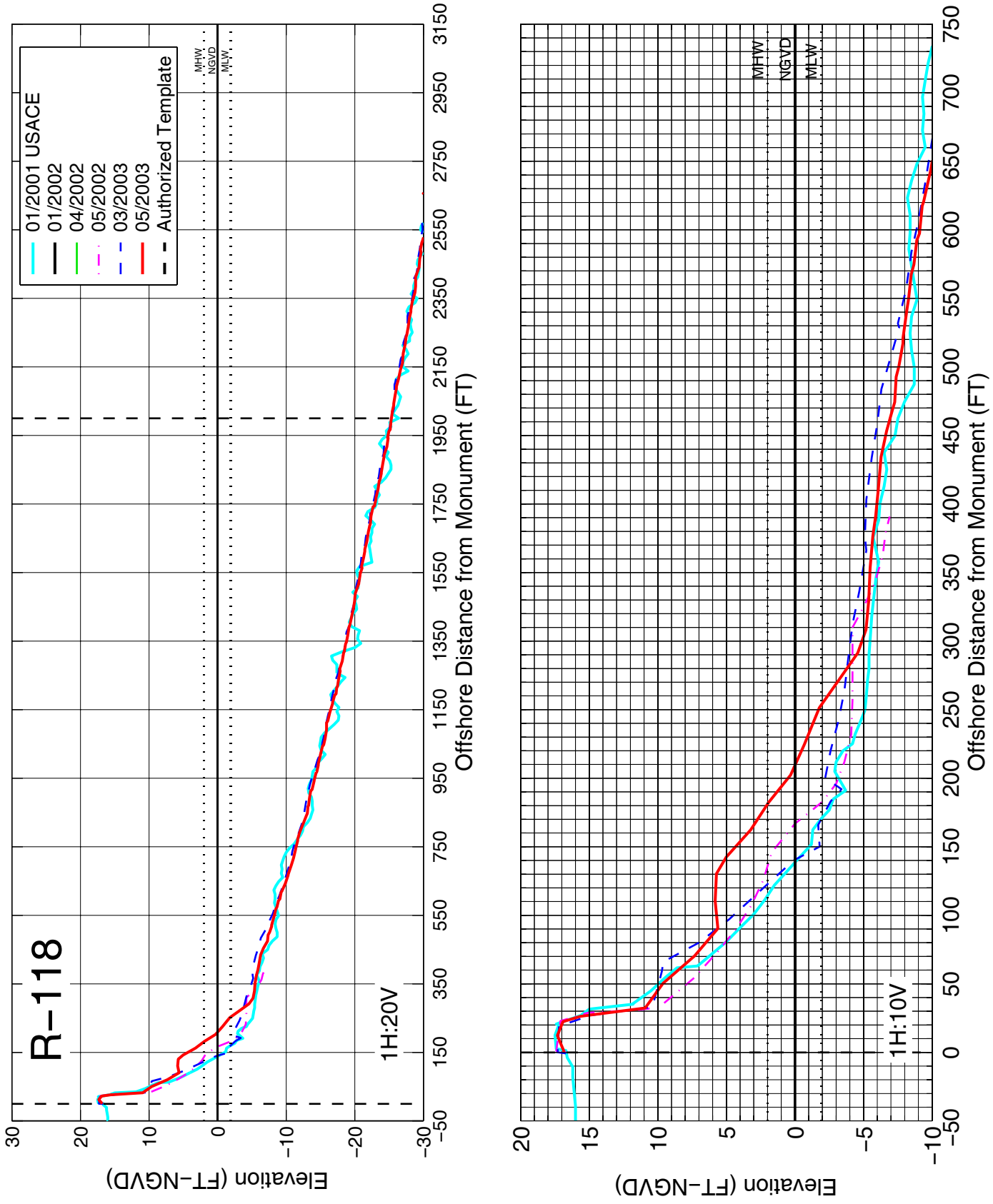


Figure A−03: Measured beach profiles at monument R−118 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

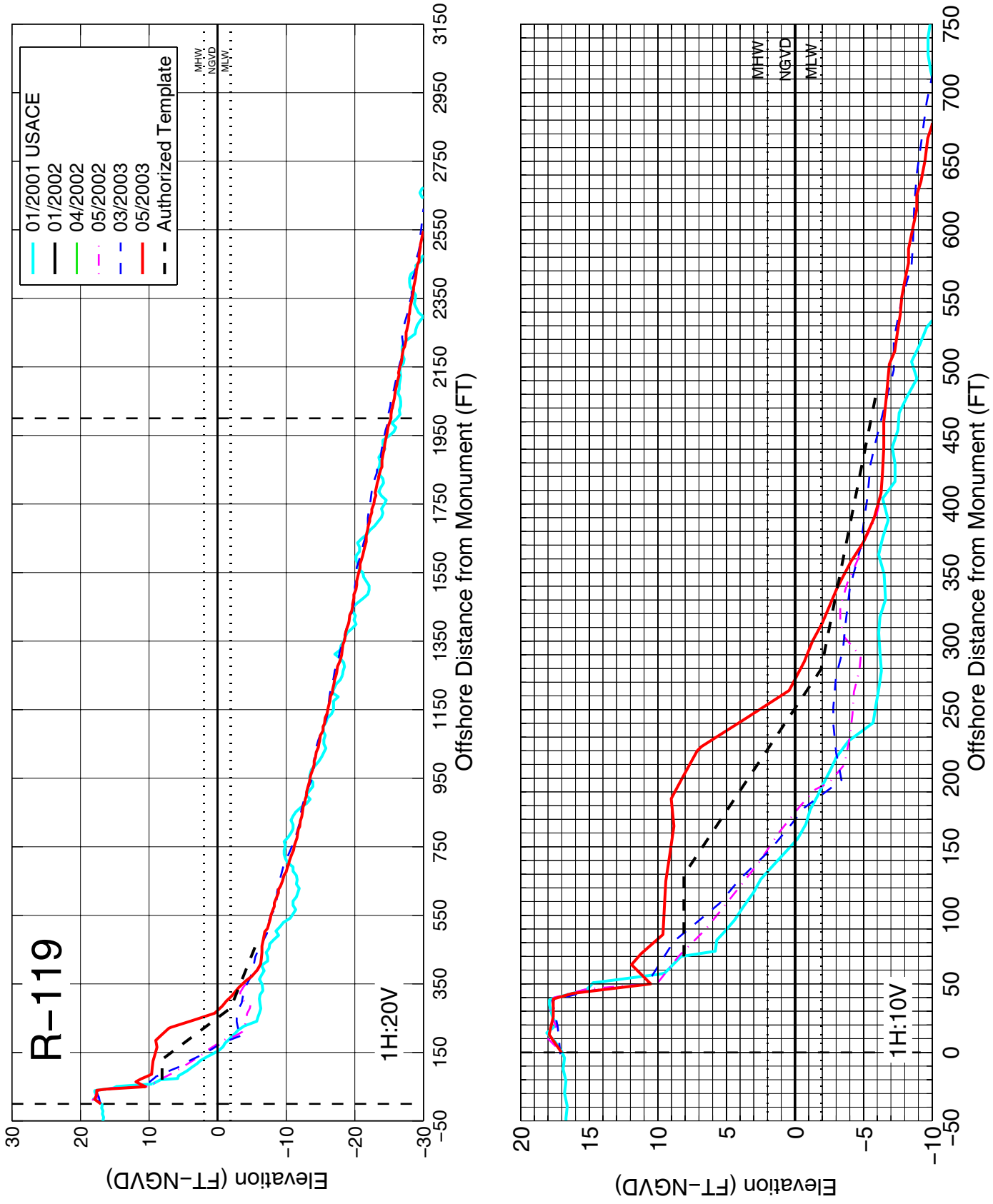


Figure A–04: Measured beach profiles at monument R–119 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

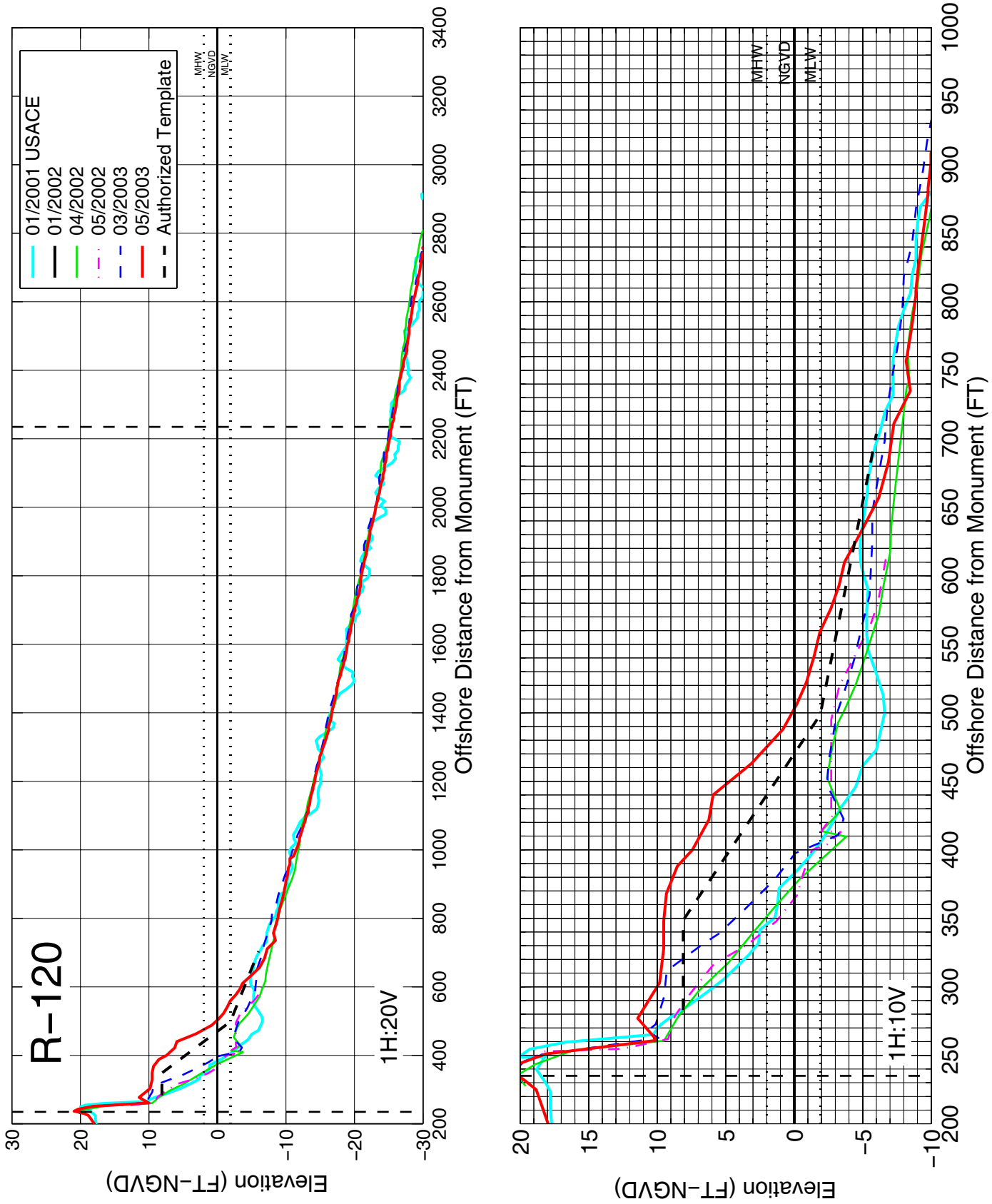


Figure A−05: Measured beach profiles at monument R−120 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

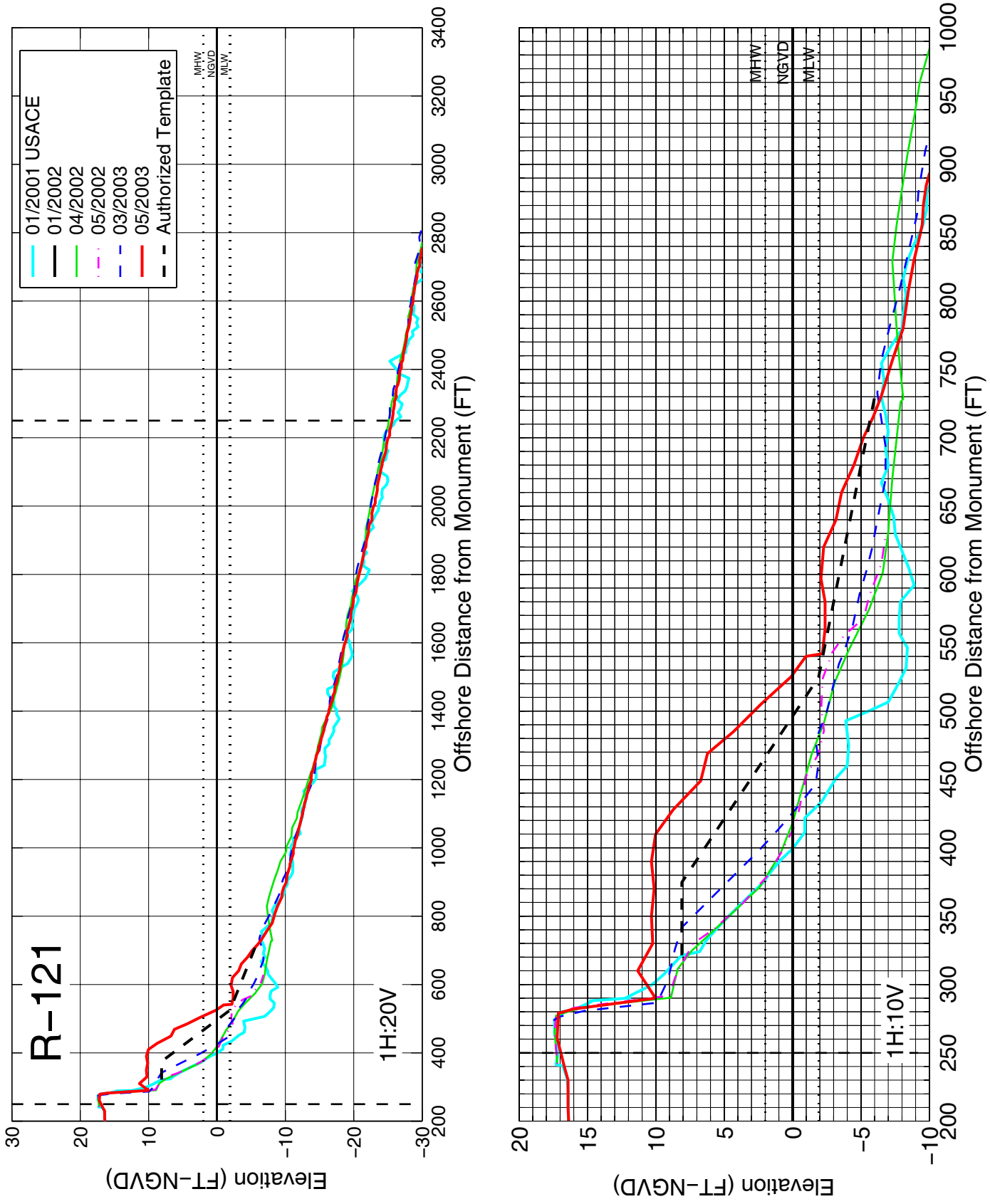


Figure A−06: Measured beach profiles at monument R−121 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

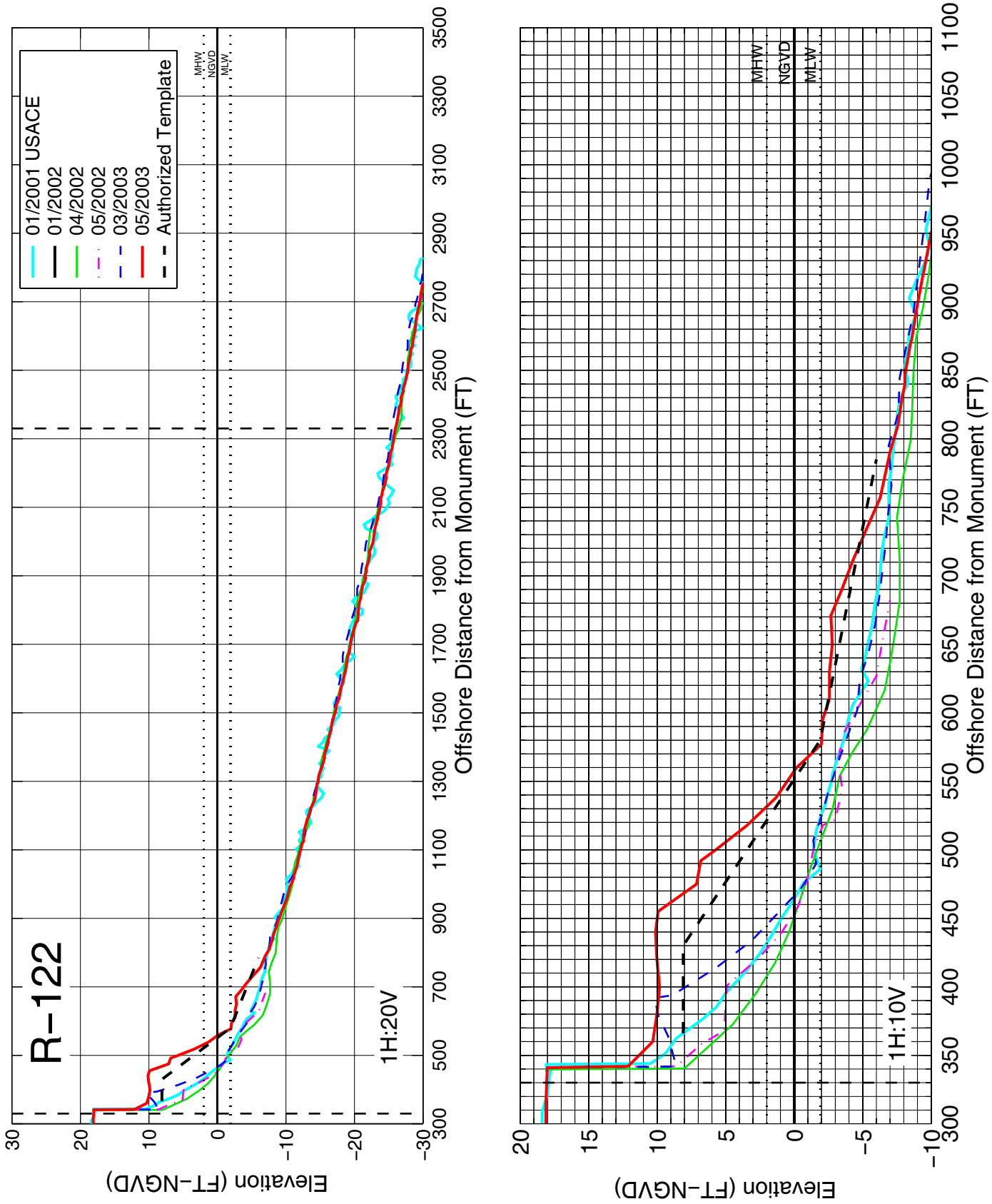


Figure A−07: Measured beach profiles at monument R−122 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

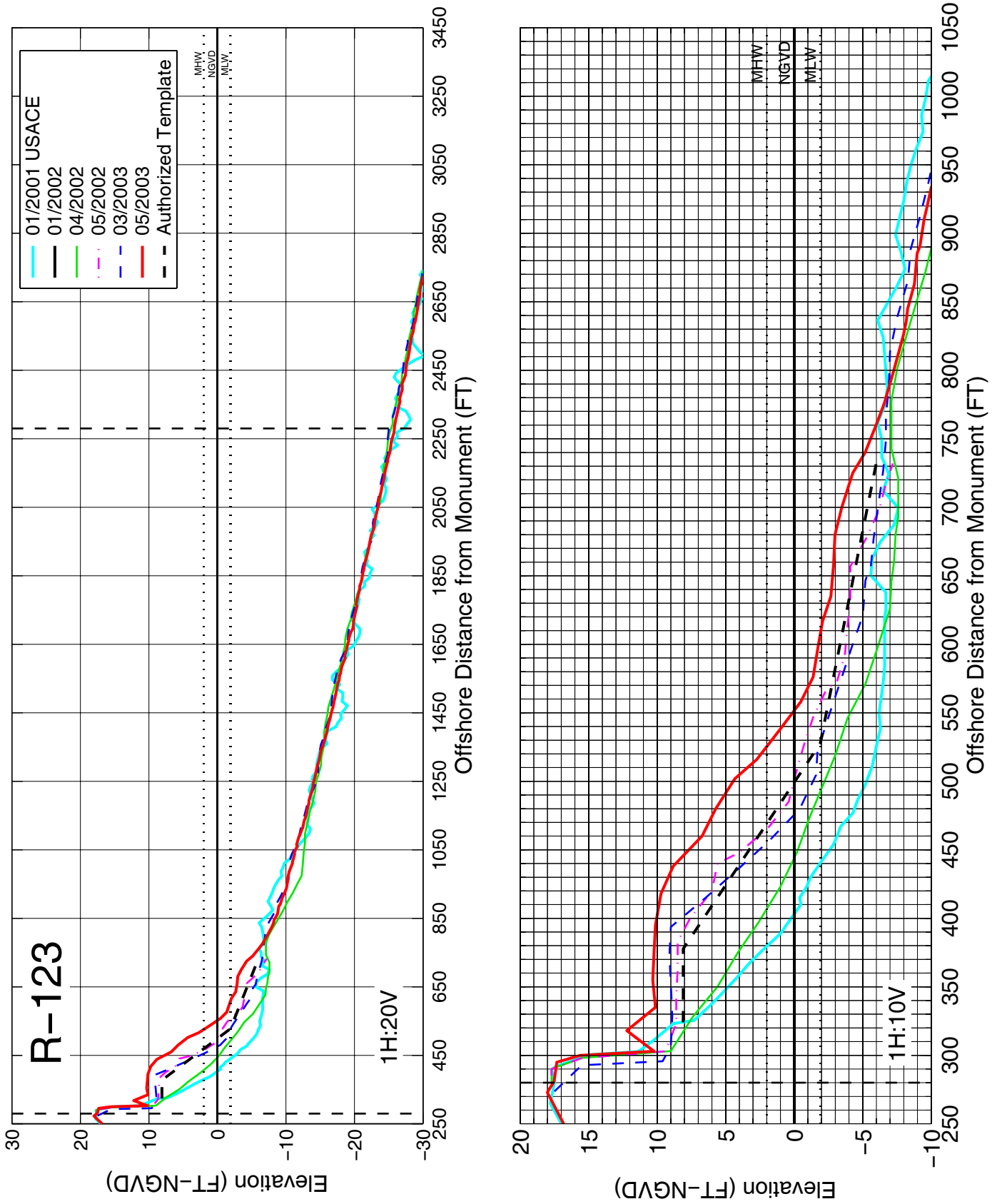


Figure A−08: Measured beach profiles at monument R−123 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

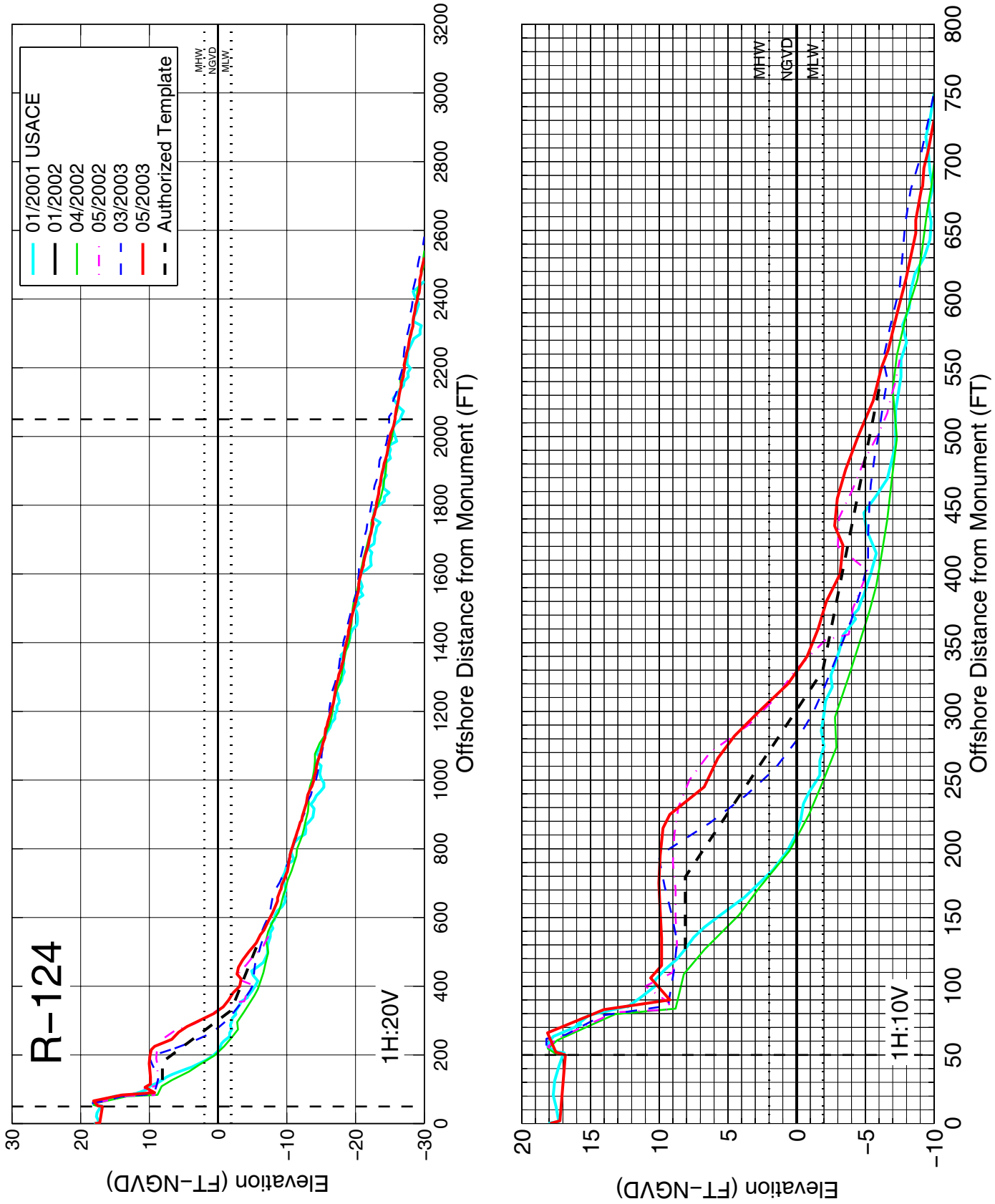


Figure A−09: Measured beach profiles at monument R−124 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

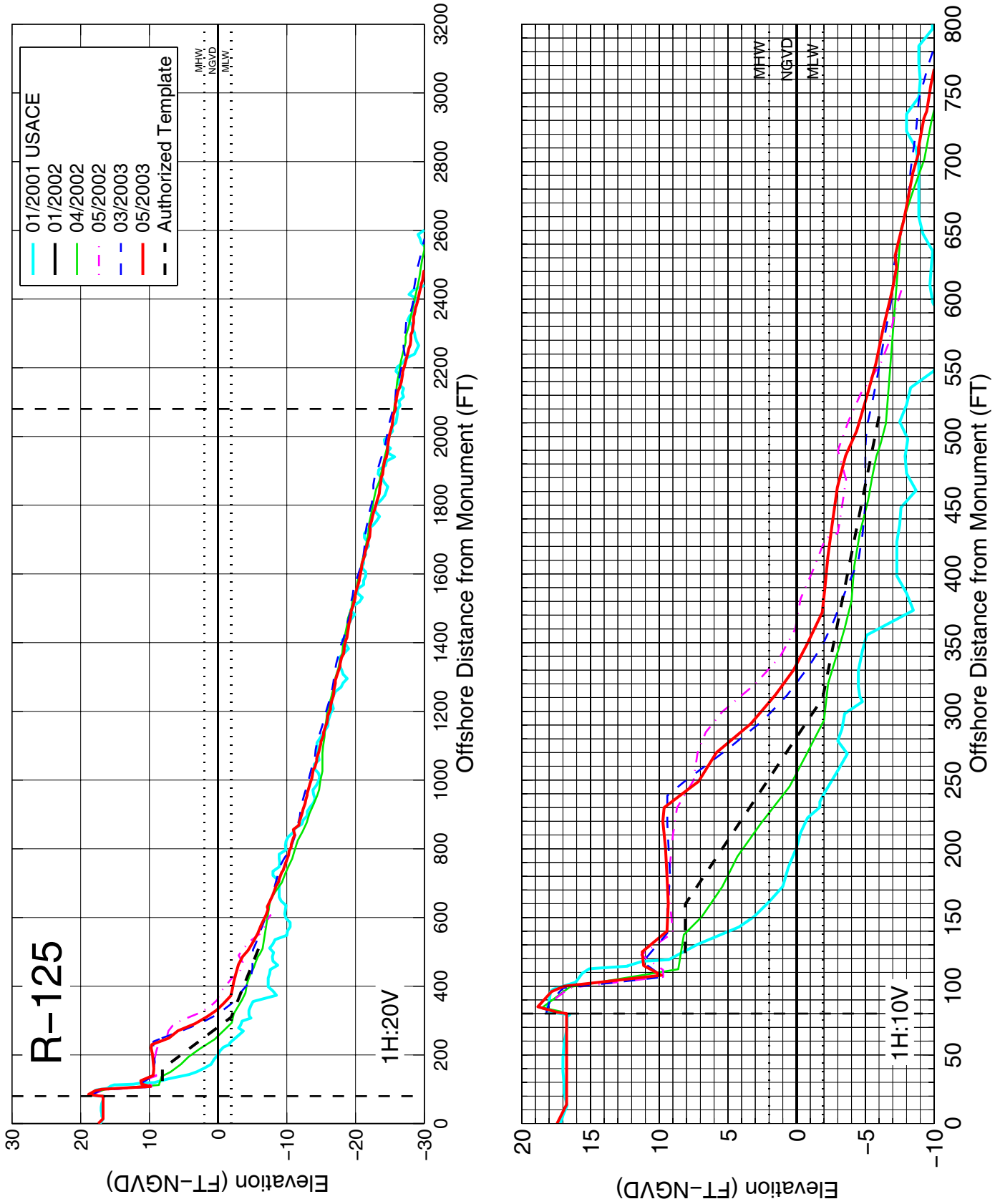


Figure A−10: Measured beach profiles at monument R−125 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

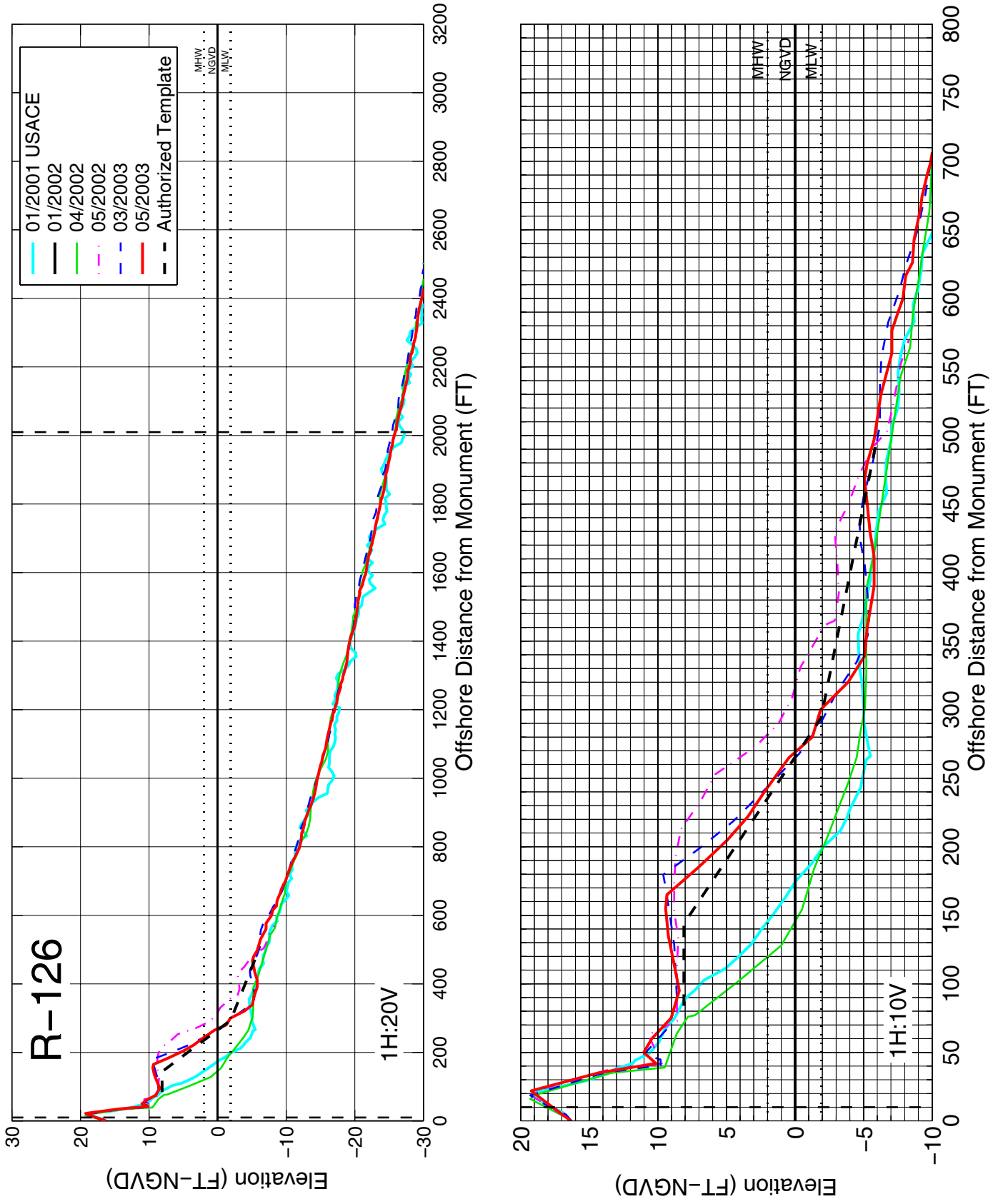


Figure A−11: Measured beach profiles at monument R−126 Brevard County, Florida. (Vertical dashed lines indicate physical limits of volume change calculations)

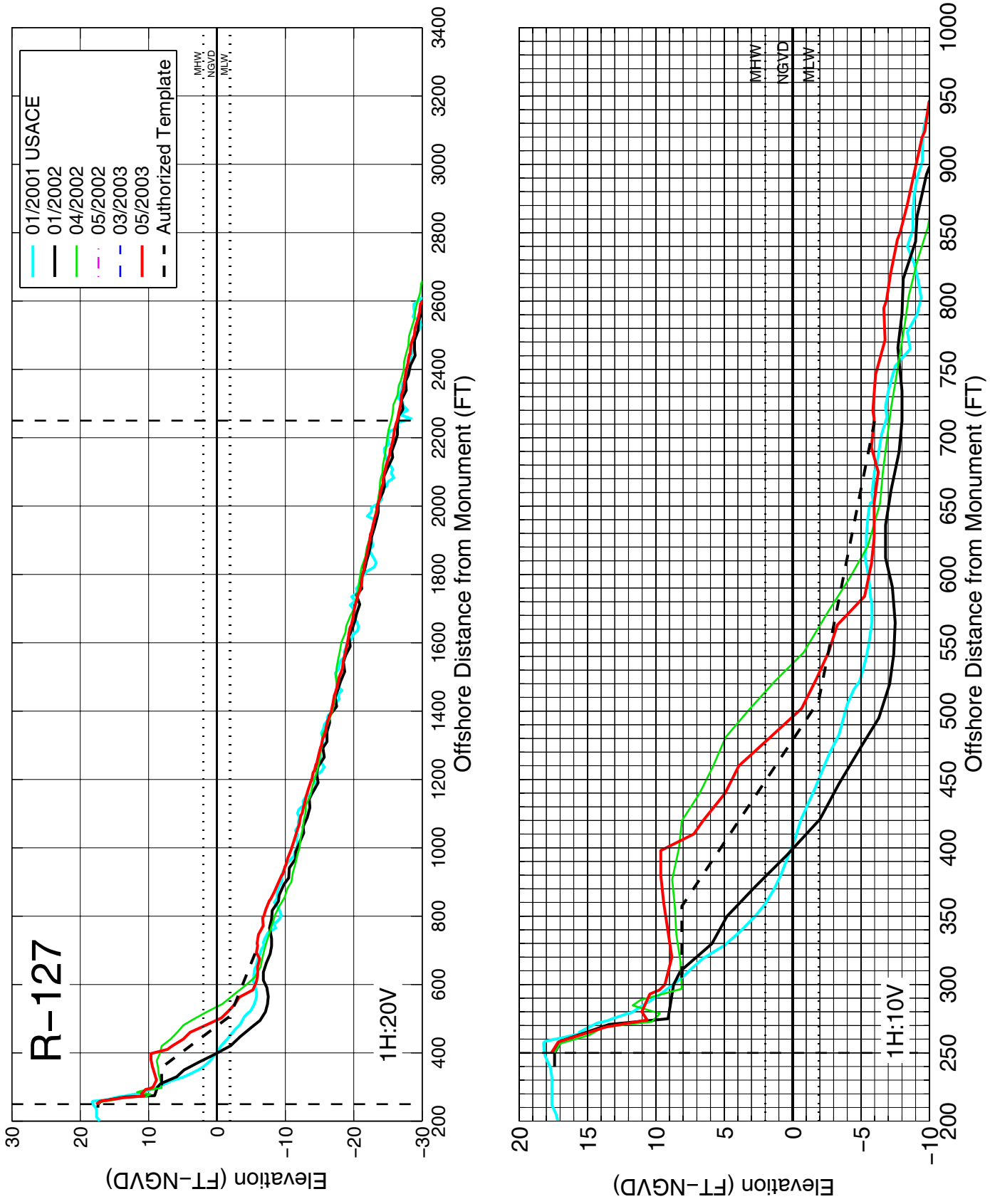


Figure A−12: Measured beach profiles at monument R−127 Brevard County, Florida. (Vertical dashed lines indicate physical limits of volume change calculations)

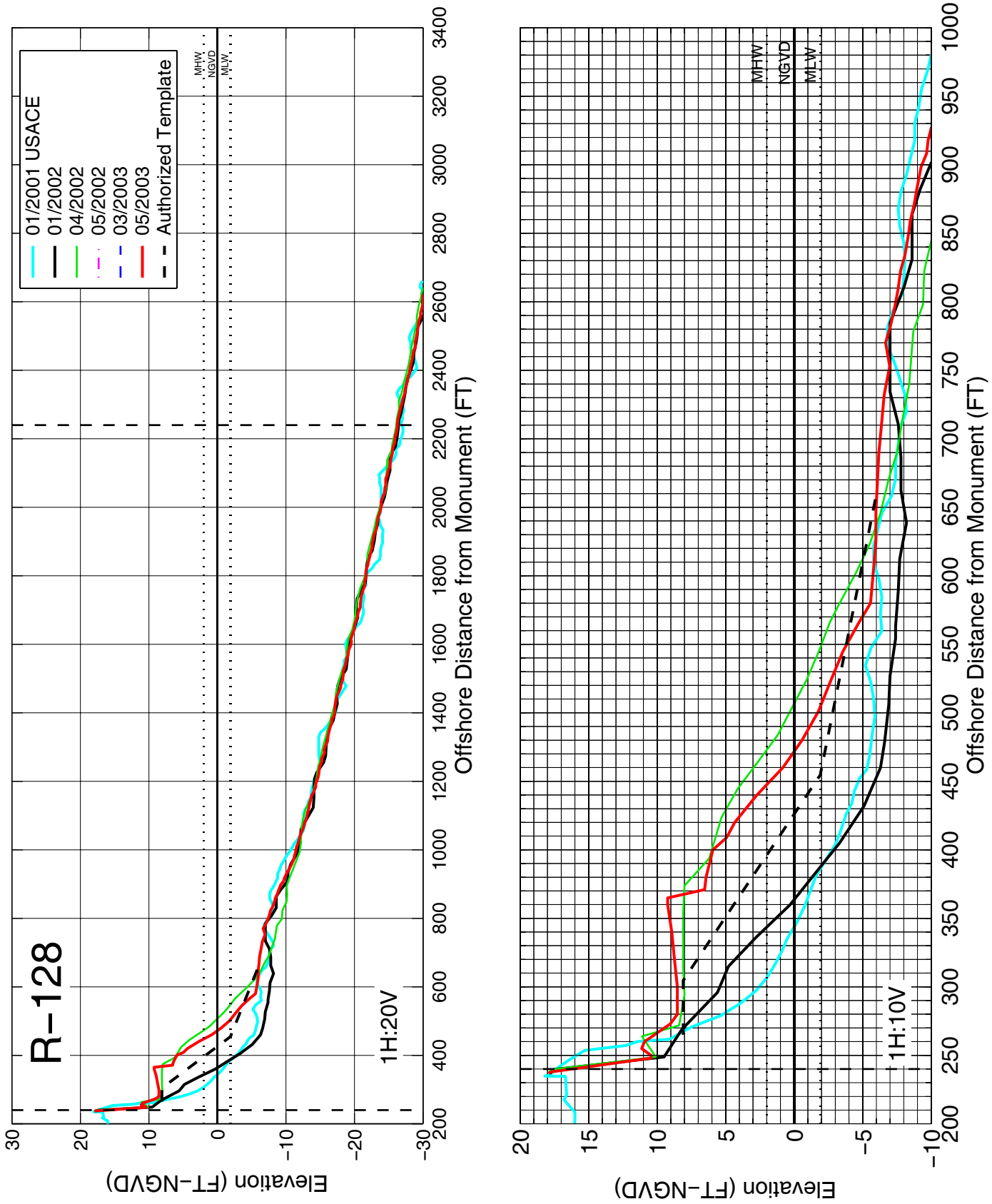


Figure A−13: Measured beach profiles at monument R−128 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

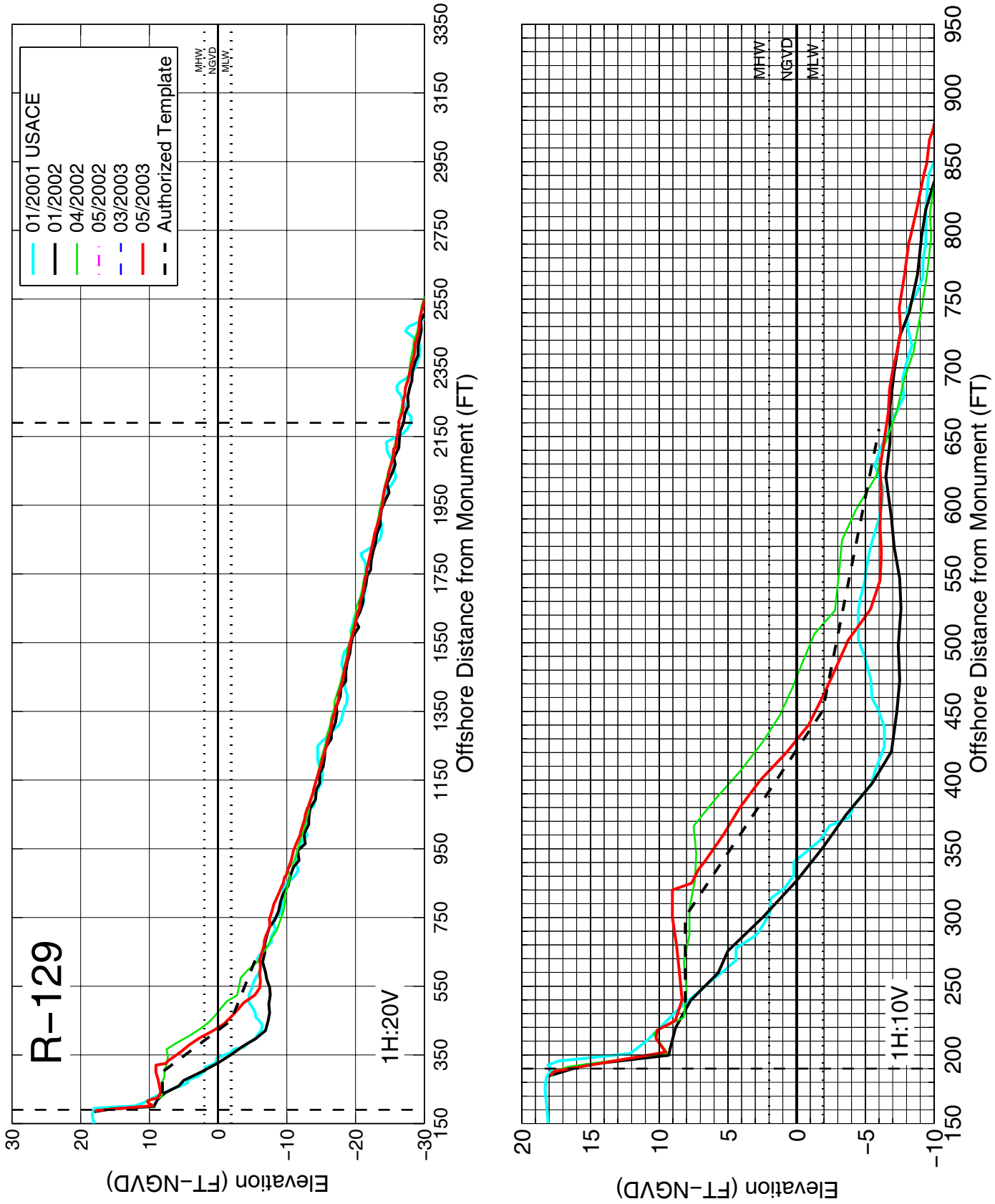


Figure A−14: Measured beach profiles at monument R−129 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

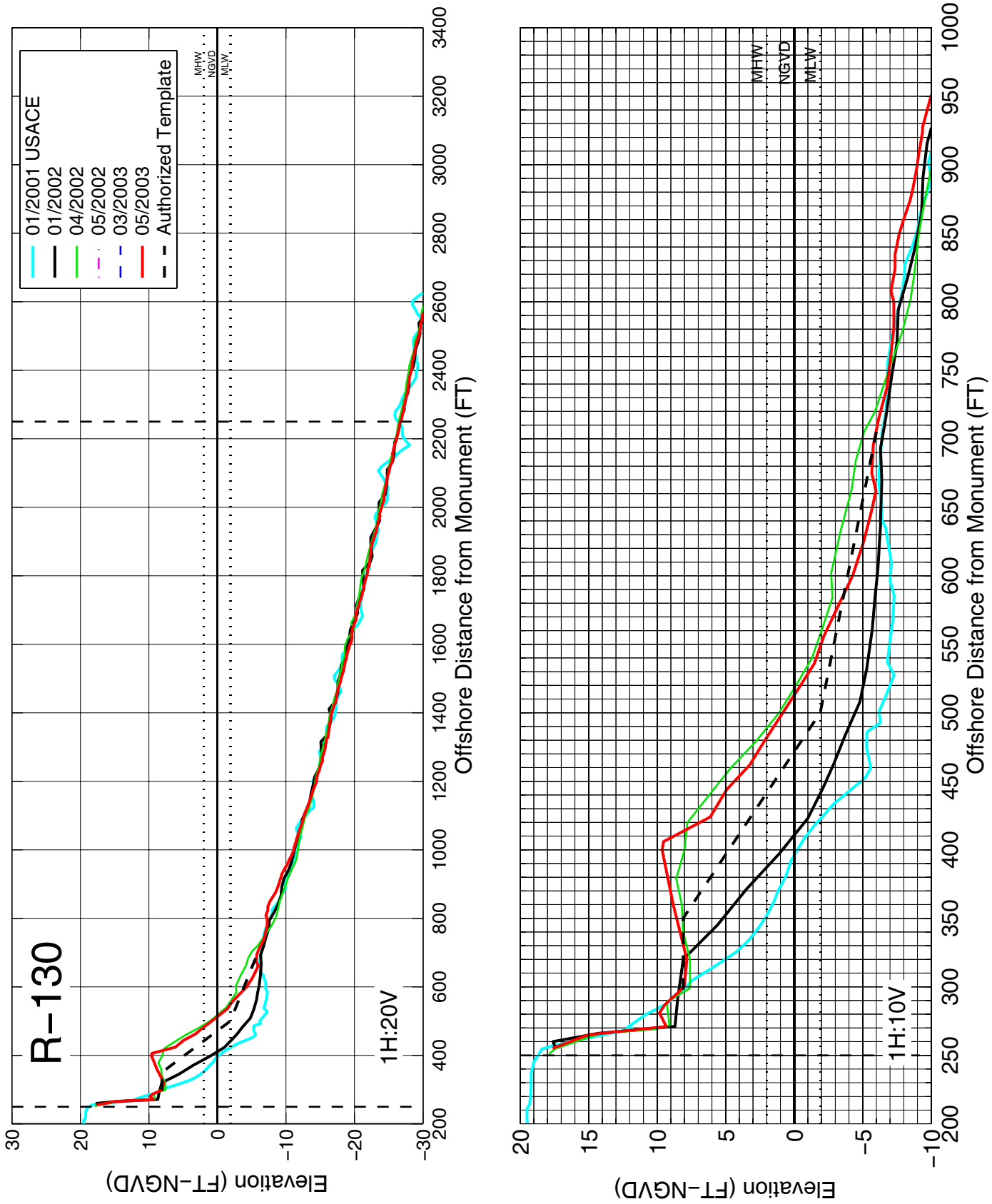


Figure A–15: Measured beach profiles at monument R–130 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

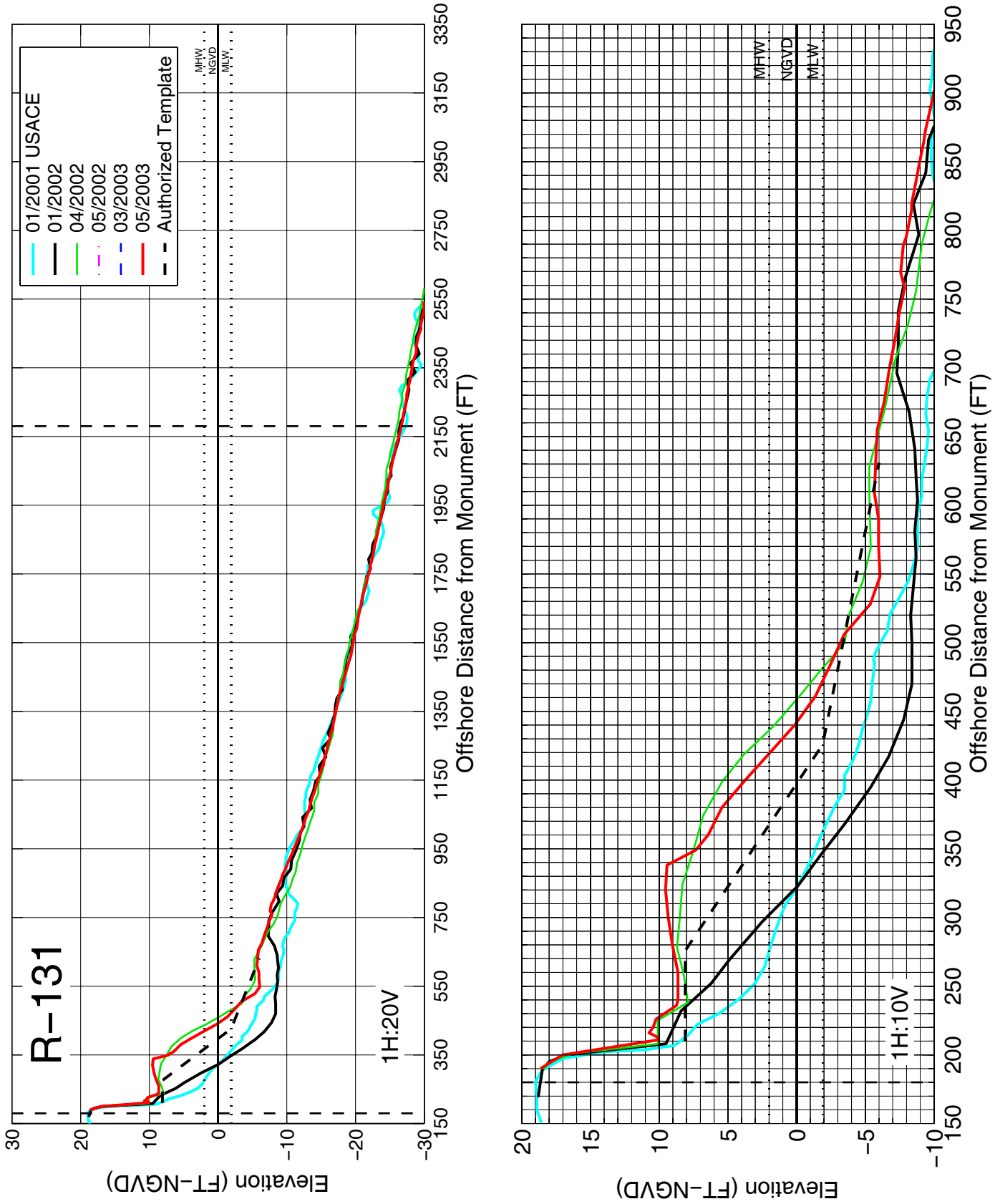


Figure A–16: Measured beach profiles at monument R–131 Brevard County, Florida. (Vertical dashed lines indicate physical limits of volume change calculations)

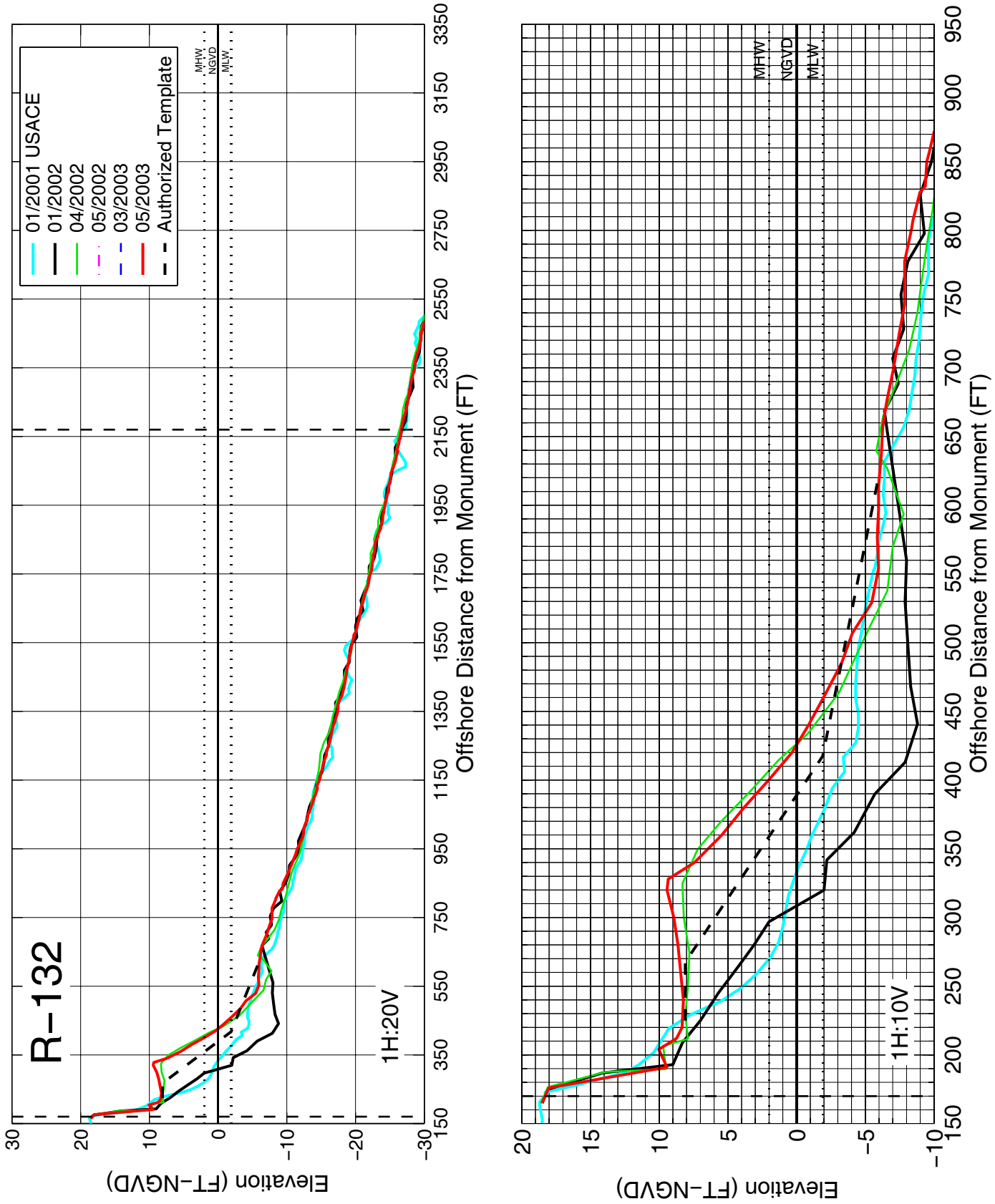


Figure A–17: Measured beach profiles at monument R–132 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

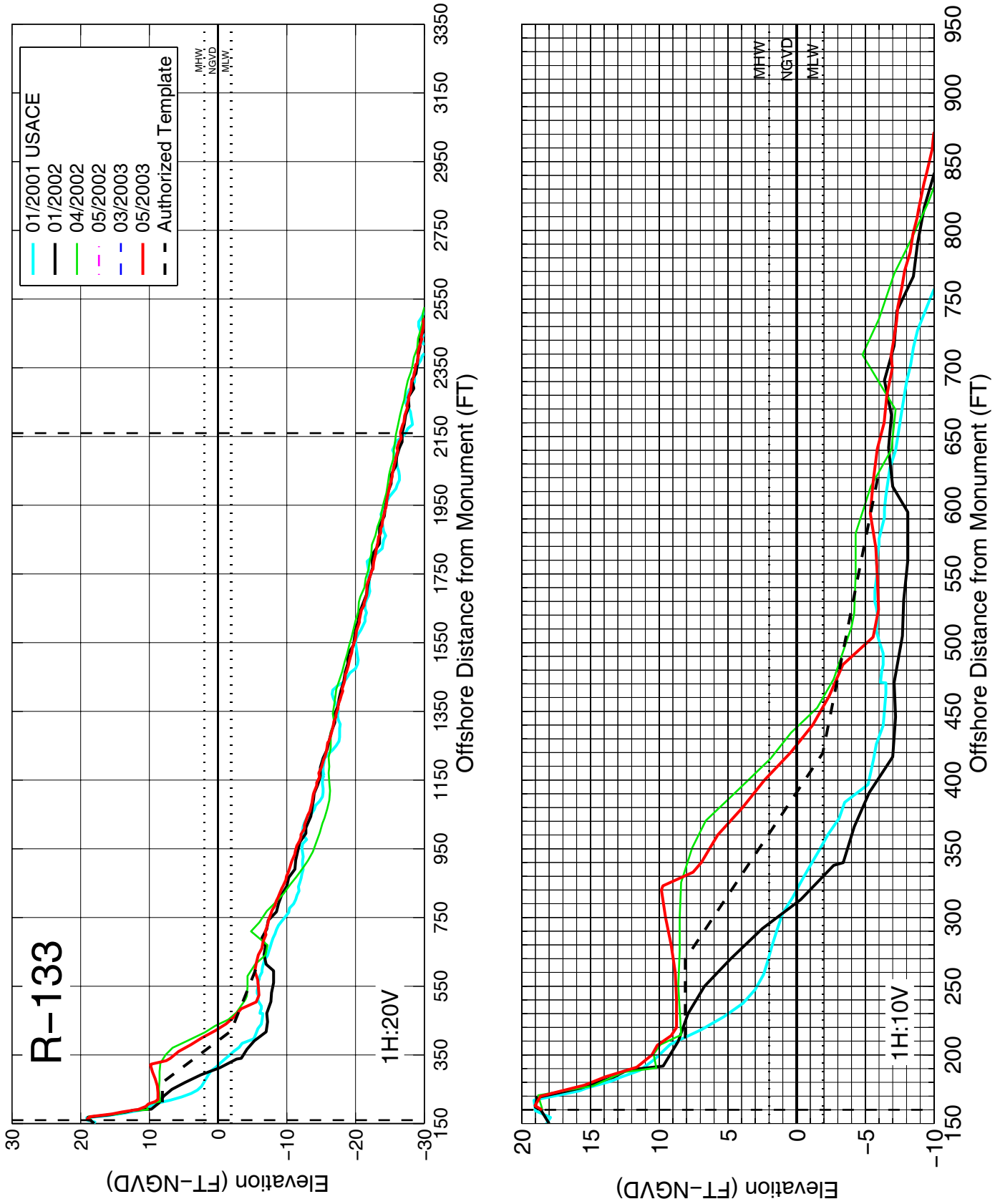


Figure A–18: Measured beach profiles at monument R–133 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

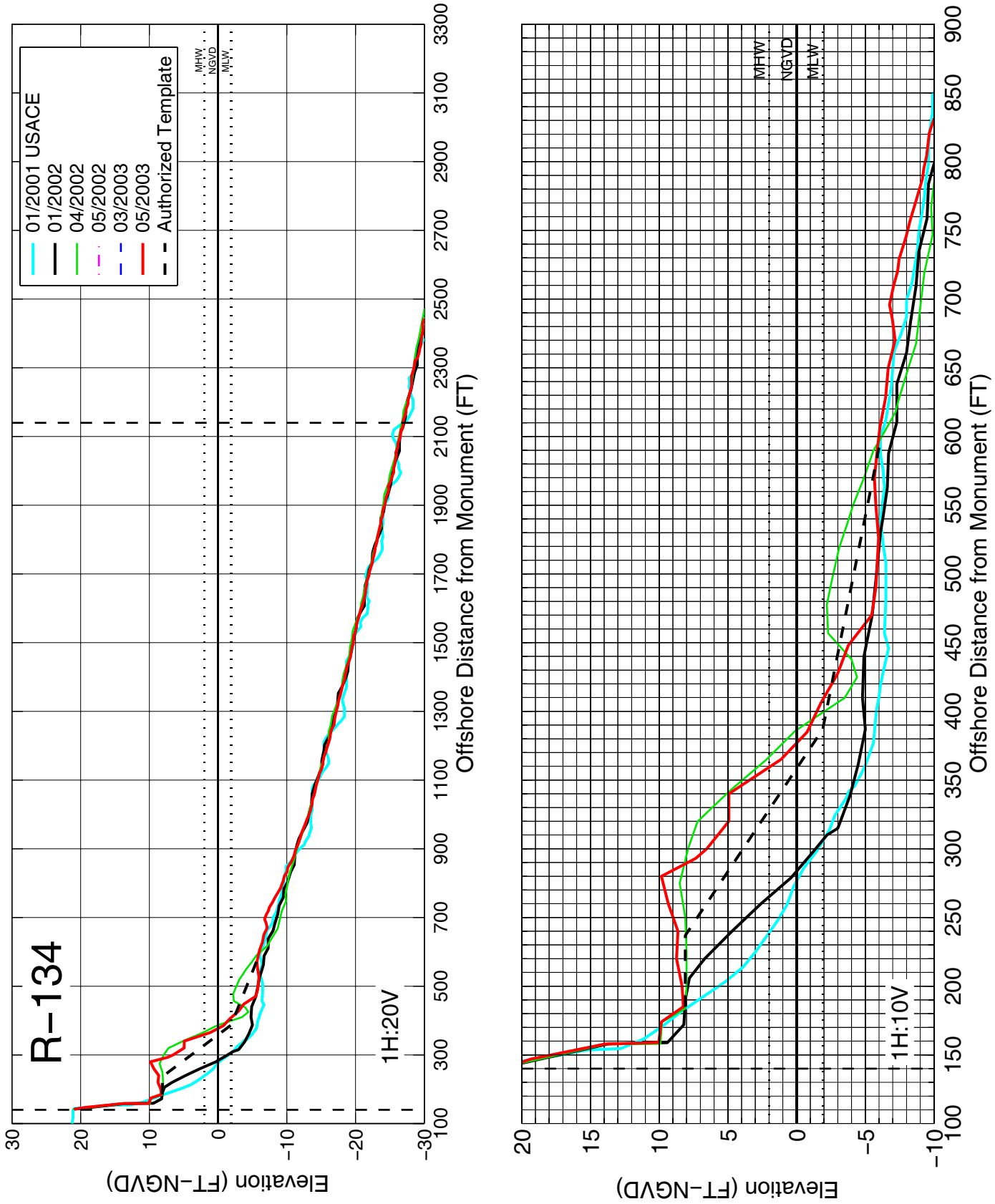


Figure A–19: Measured beach profiles at monument R–134 Brevard County, Florida. (Vertical dashed lines indicate physical limits of volume change calculations)

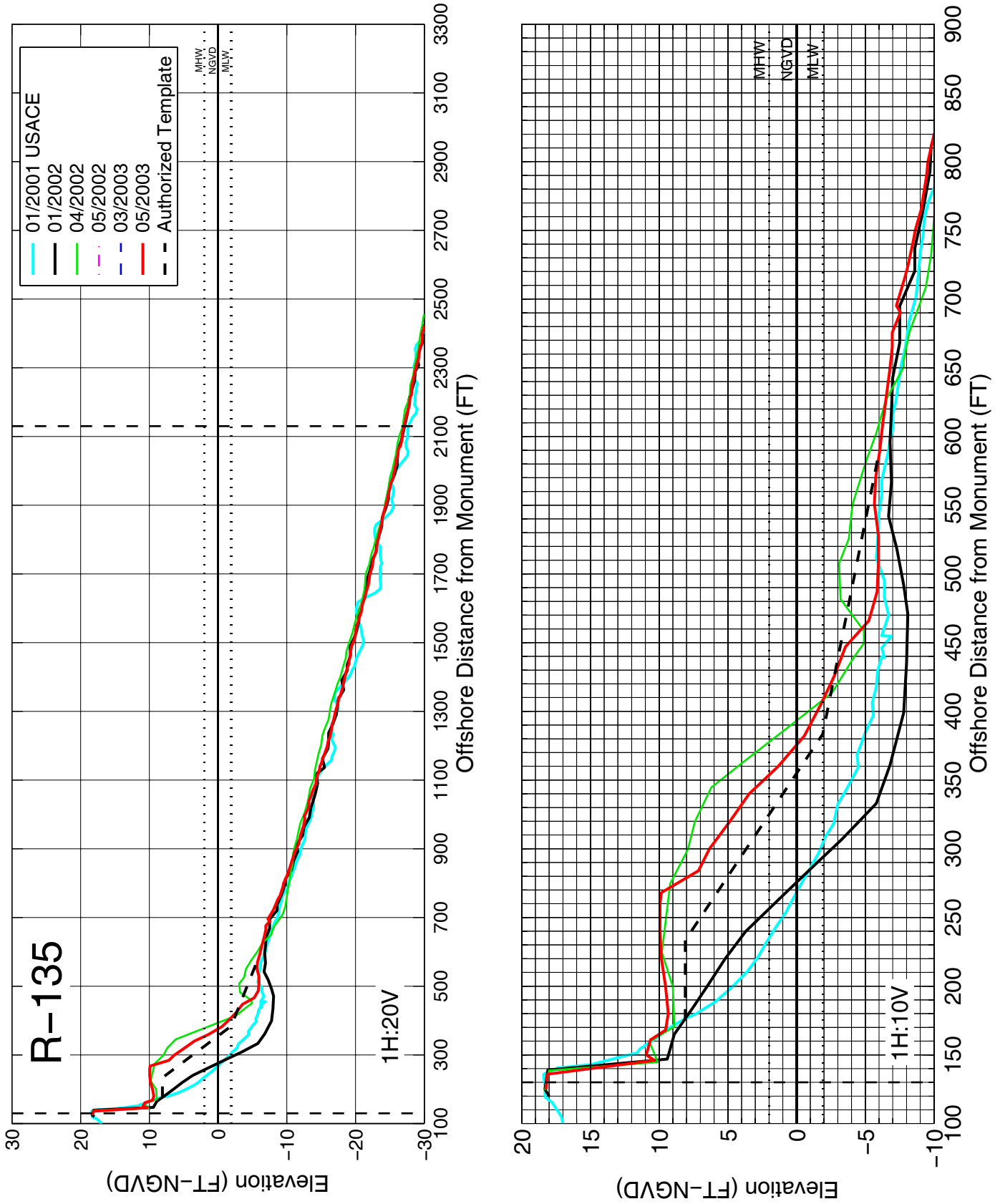


Figure A–20: Measured beach profiles at monument R–135 Brevard County, Florida. (Vertical dashed lines indicate physical limits of volume change calculations)

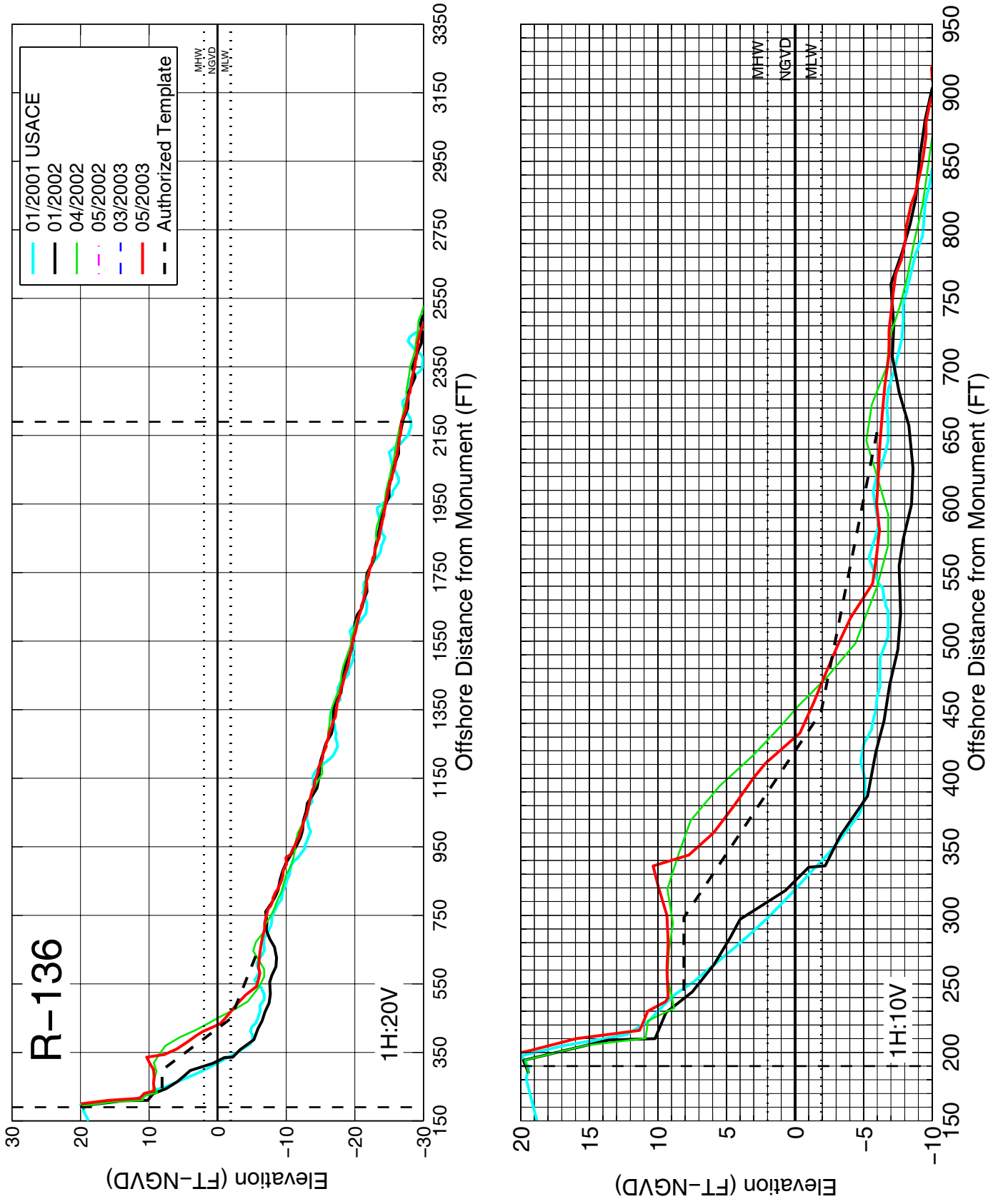


Figure A–21: Measured beach profiles at monument R–136 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

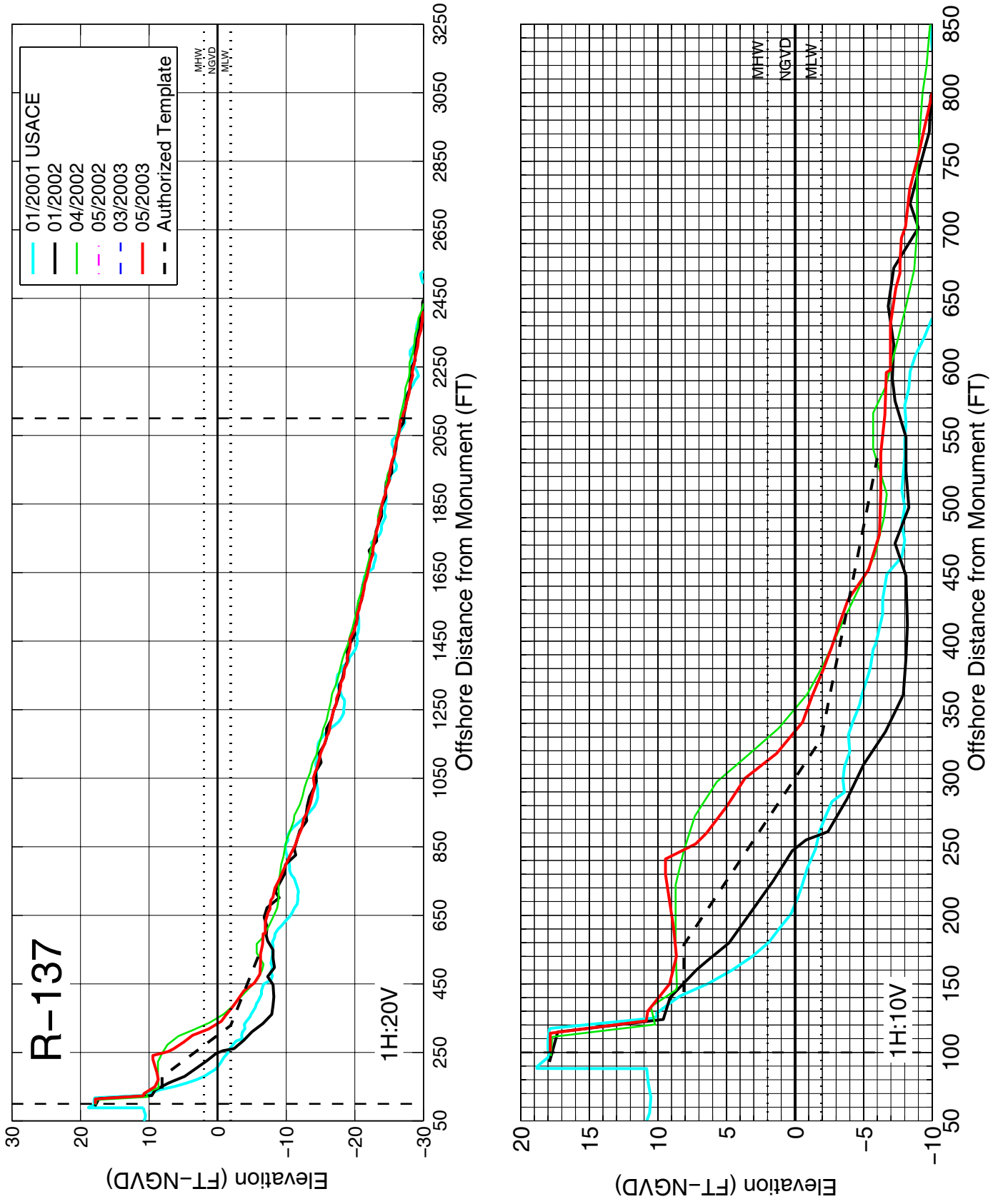


Figure A–22: Measured beach profiles at monument R–137 Brevard County, Florida. (Vertical dashed lines indicate physical limits of volume change calculations)

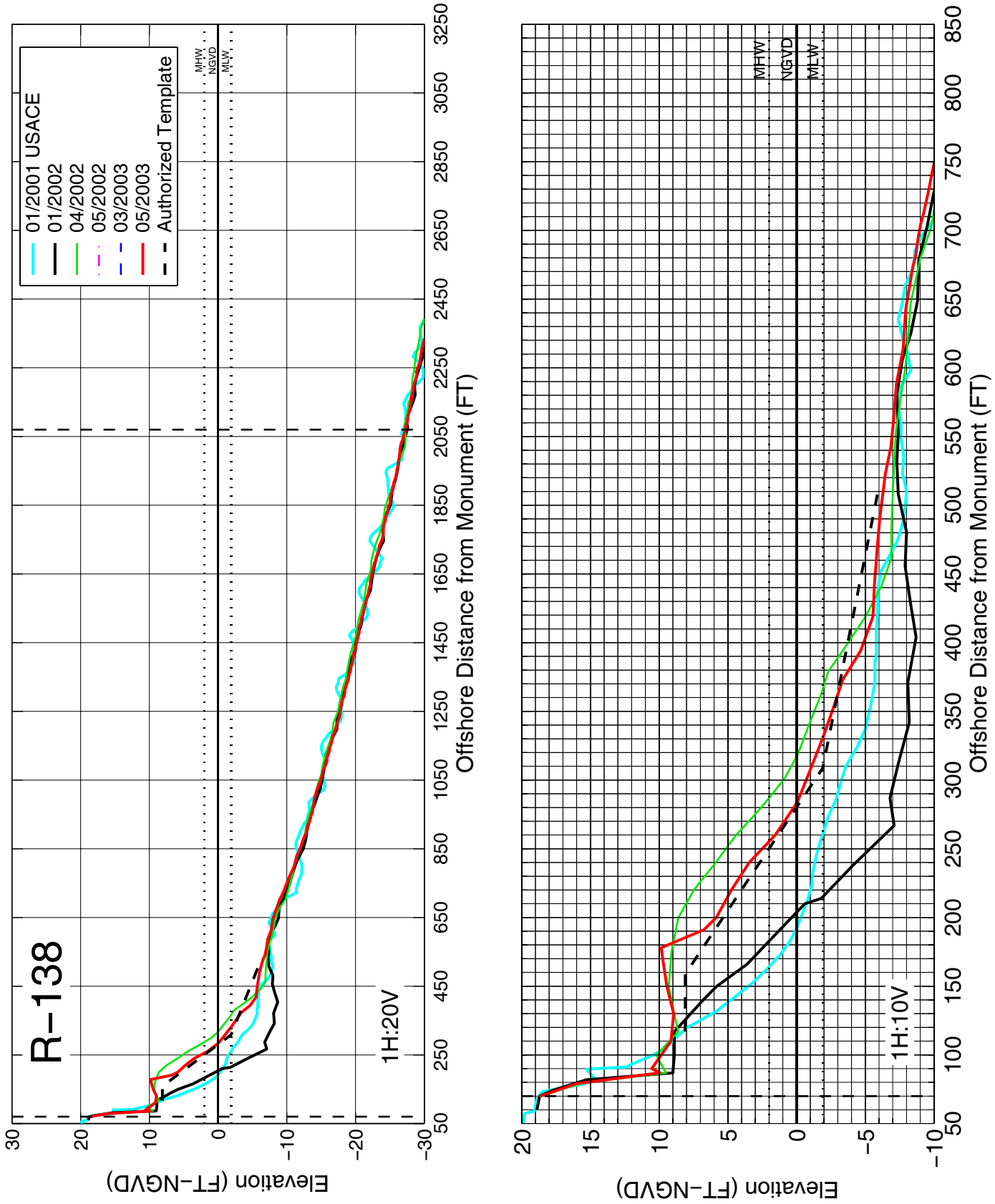


Figure A−23: Measured beach profiles at monument R−138 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

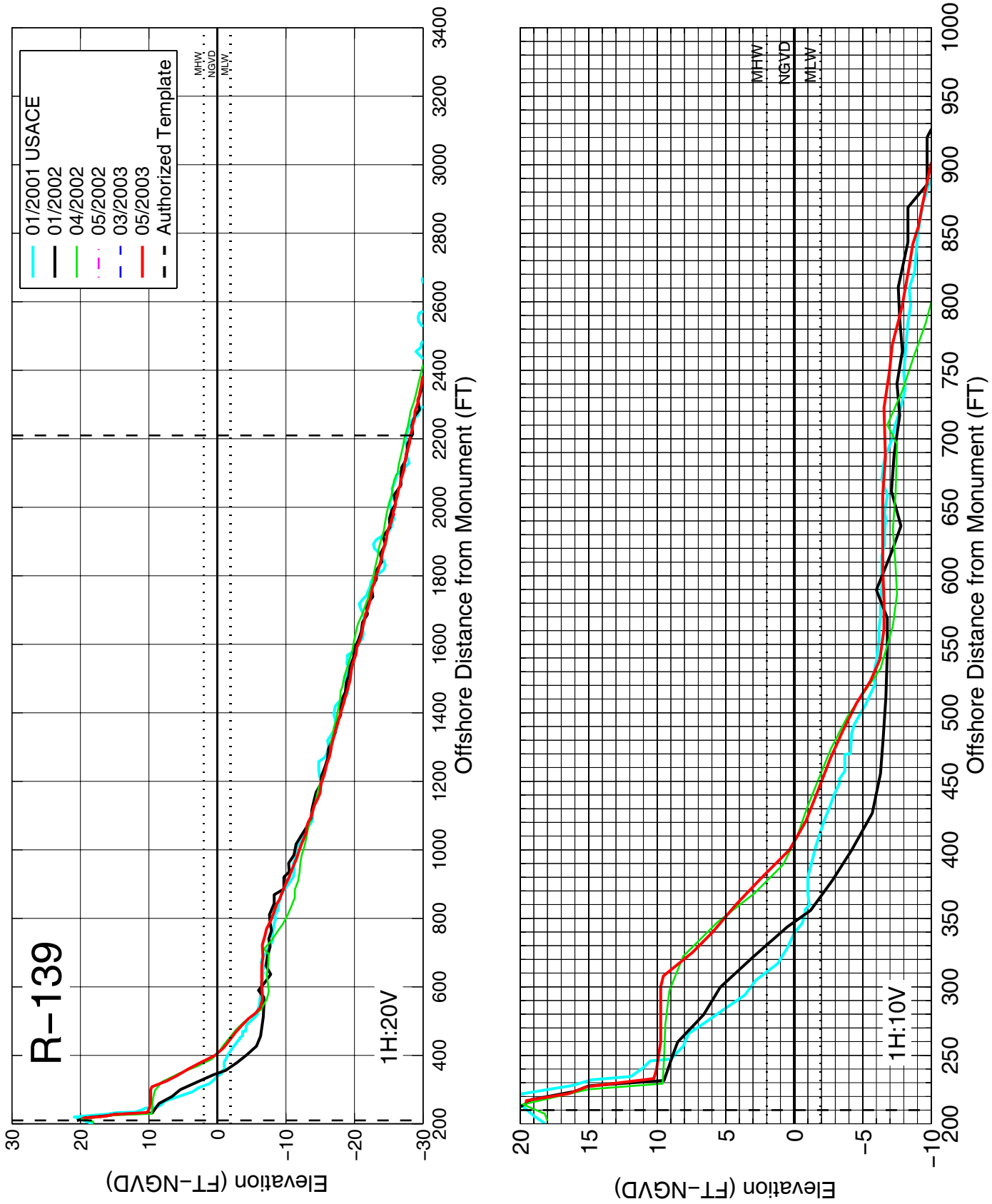


Figure A–24: Measured beach profiles at monument R–139 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

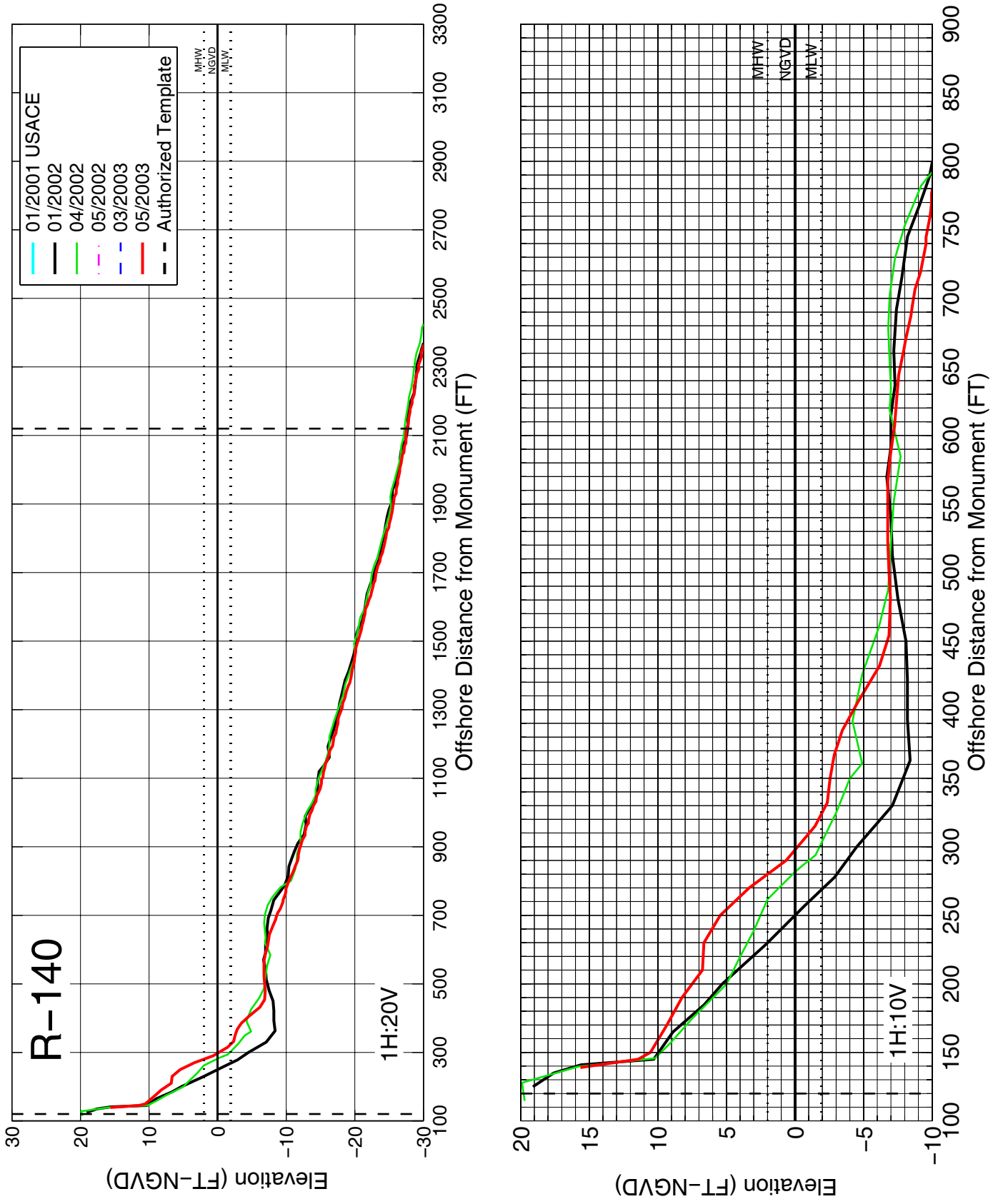


Figure A–25: Measured beach profiles at monument R–140 Brevard County, Florida. (Vertical dashed lines indicate physical limits of volume change calculations)

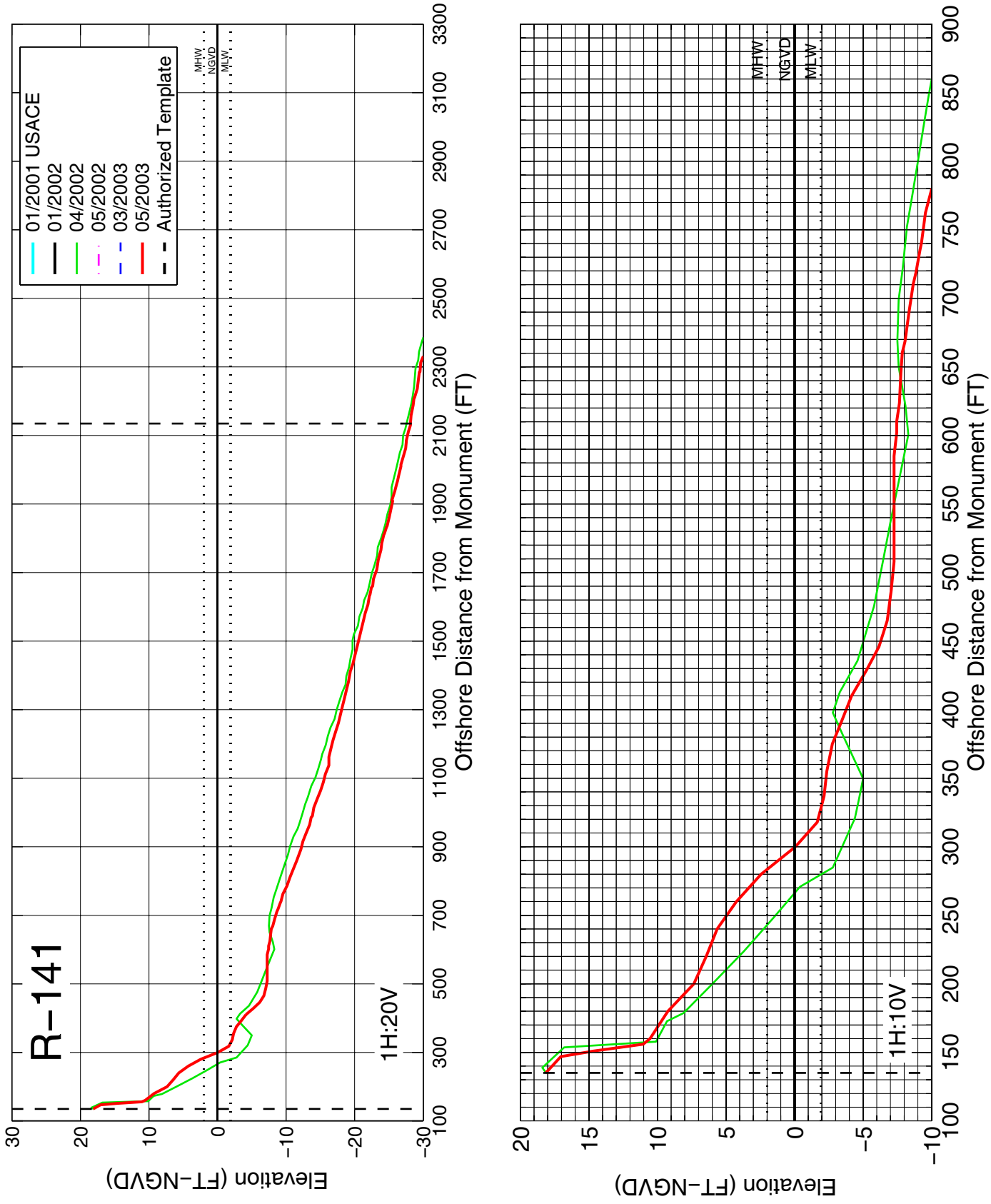


Figure A–26: Measured beach profiles at monument R–141 Brevard County, Florida. (Vertical dashed lines indicate physical limits of volume change calculations)

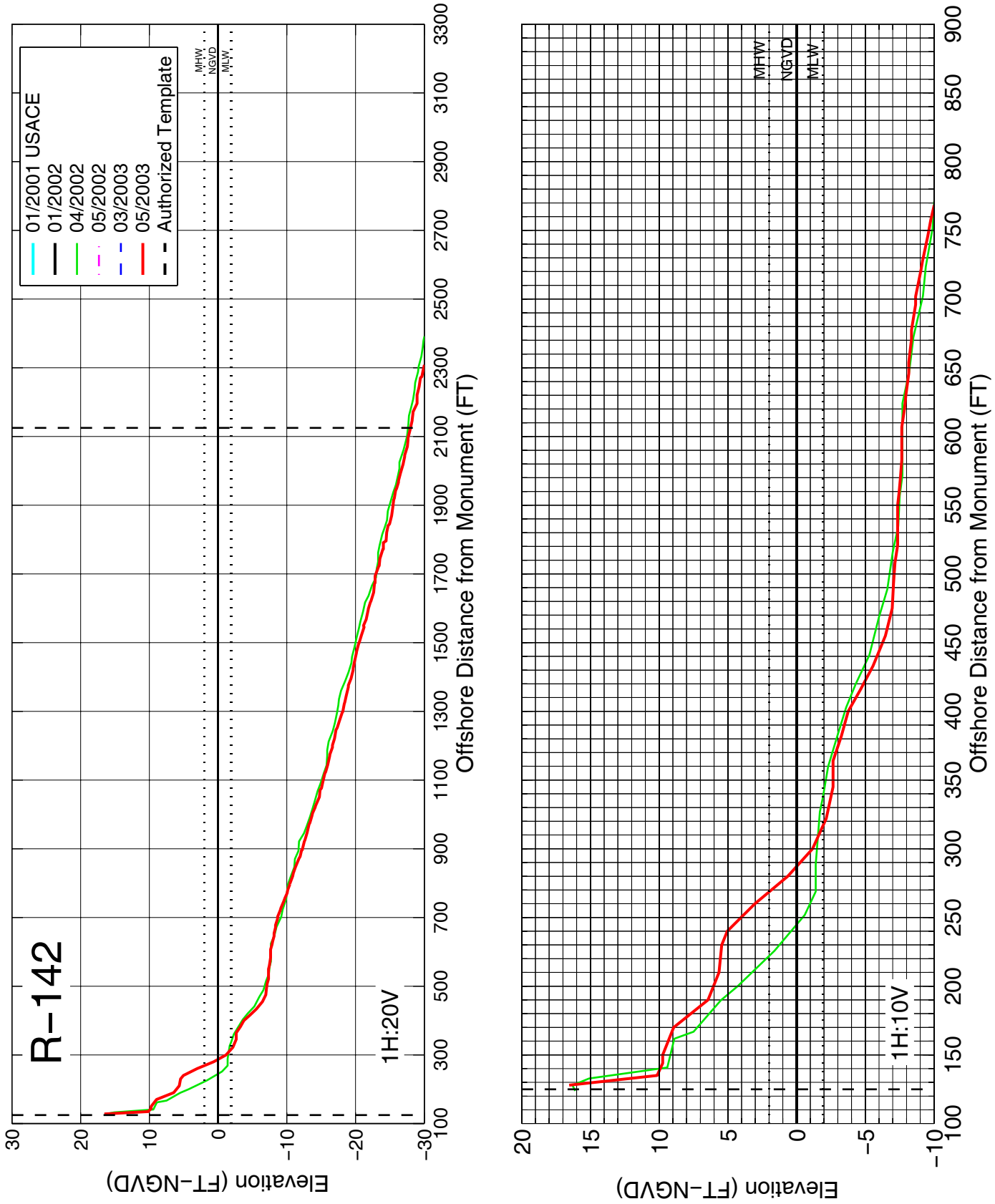


Figure A–27: Measured beach profiles at monument R–142 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

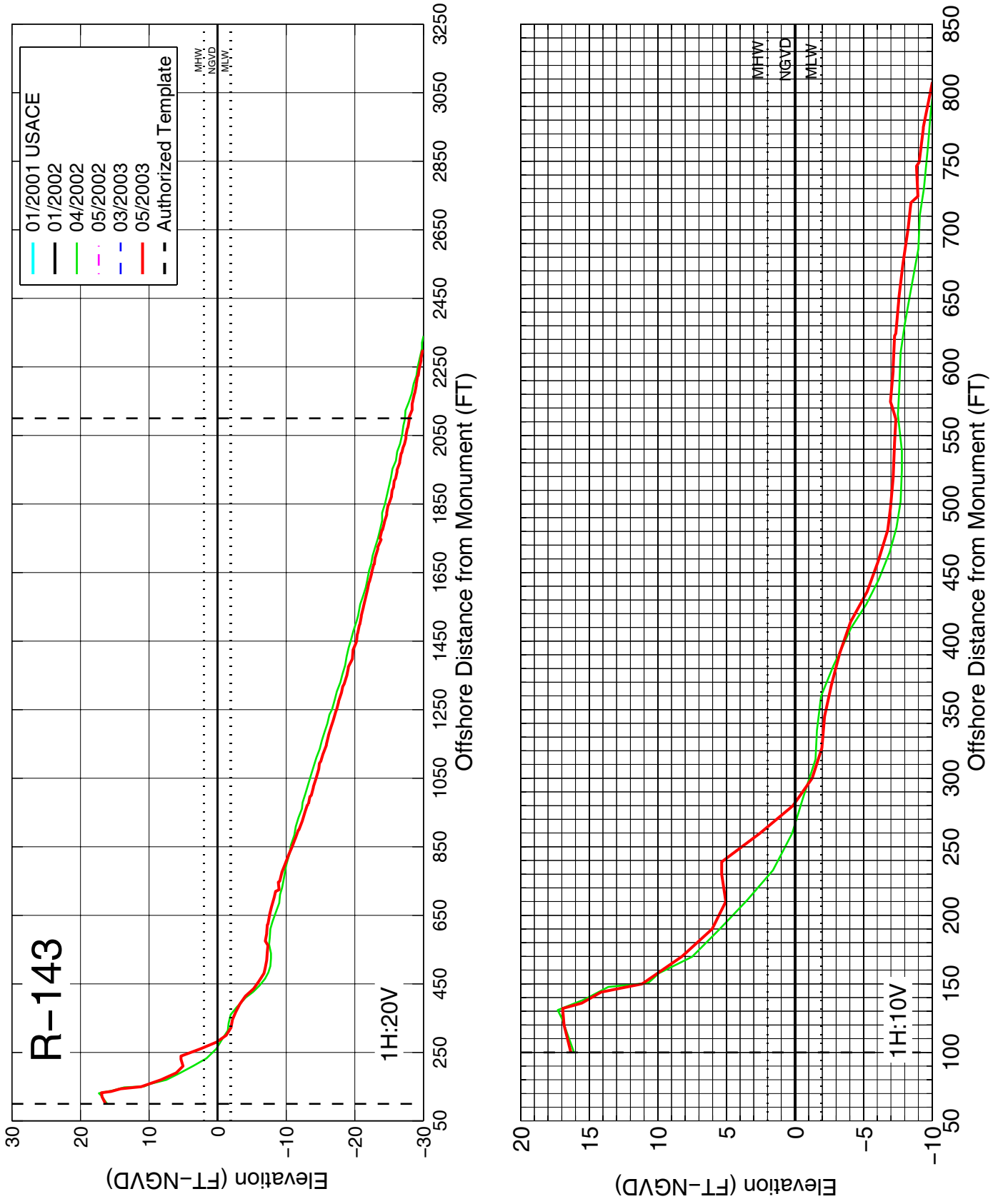


Figure A−28: Measured beach profiles at monument R−143 Brevard County, Florida.
(Vertical dashed lines indicate physical limits of volume change calculations)

APPENDIX B:

Brevard County Street & Public Beach Access Locations

This appendix contains maps depicting street names and locations as well as public beach access locations for Brevard County between R-001 and R-219. These are from Olsen (1989) and are presented for cartographic reference only. The parking and access data have not been updated to reflect 2003 conditions.

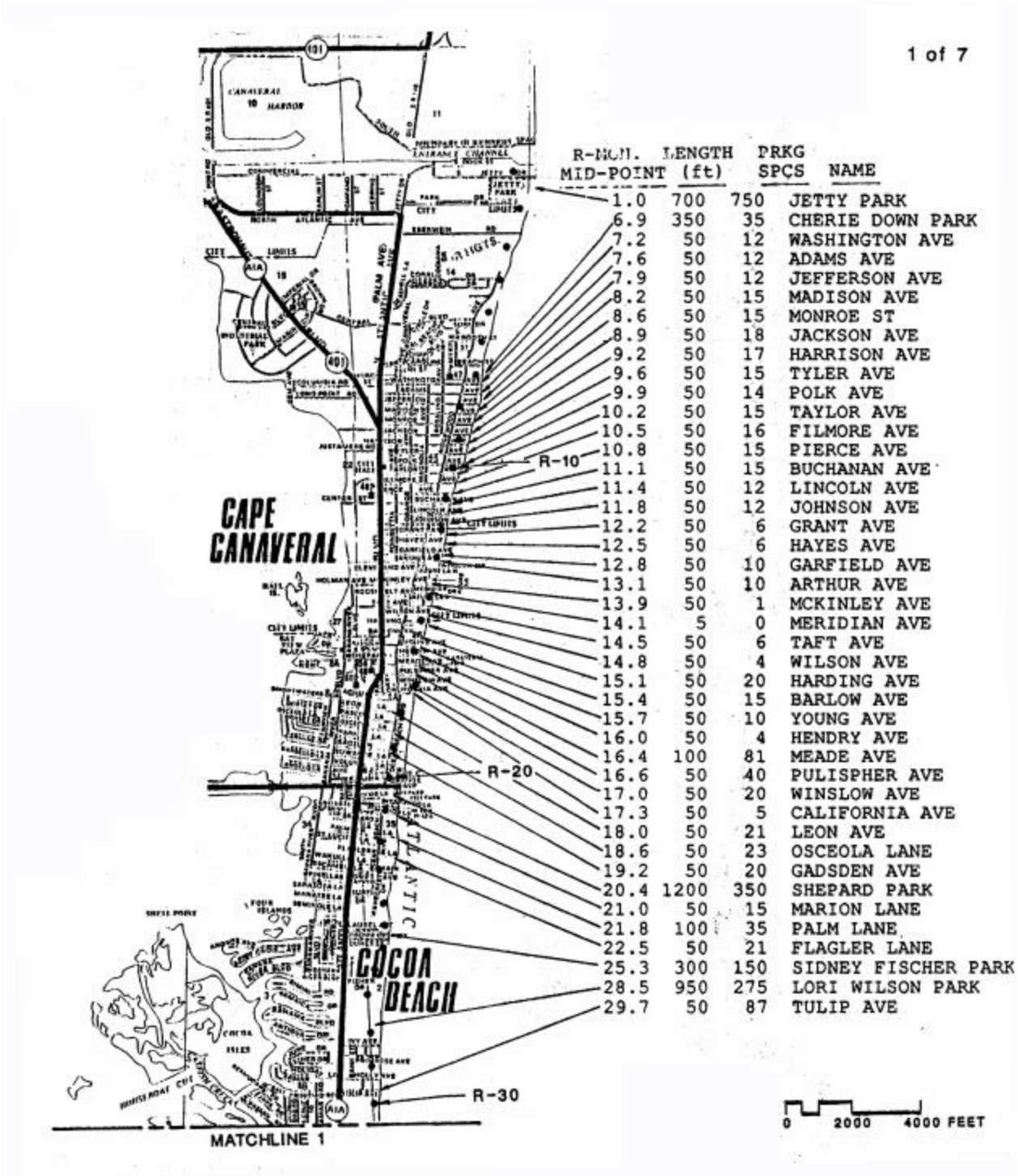


Figure B.1: Brevard County street and public beach access locations (R-001 to R-030).

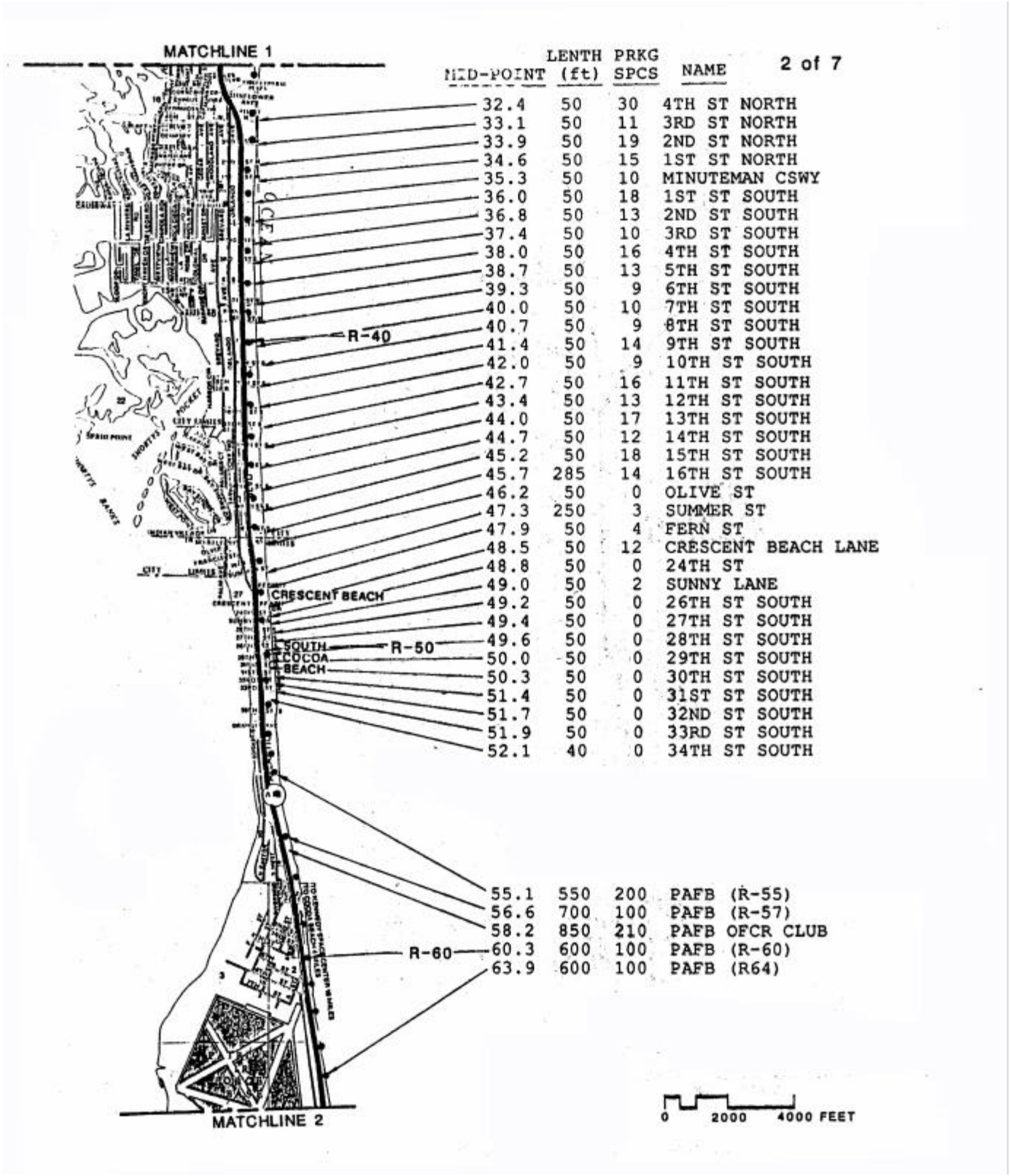


Figure B.2: Brevard County street and public beach access locations (R-031 to R-064).

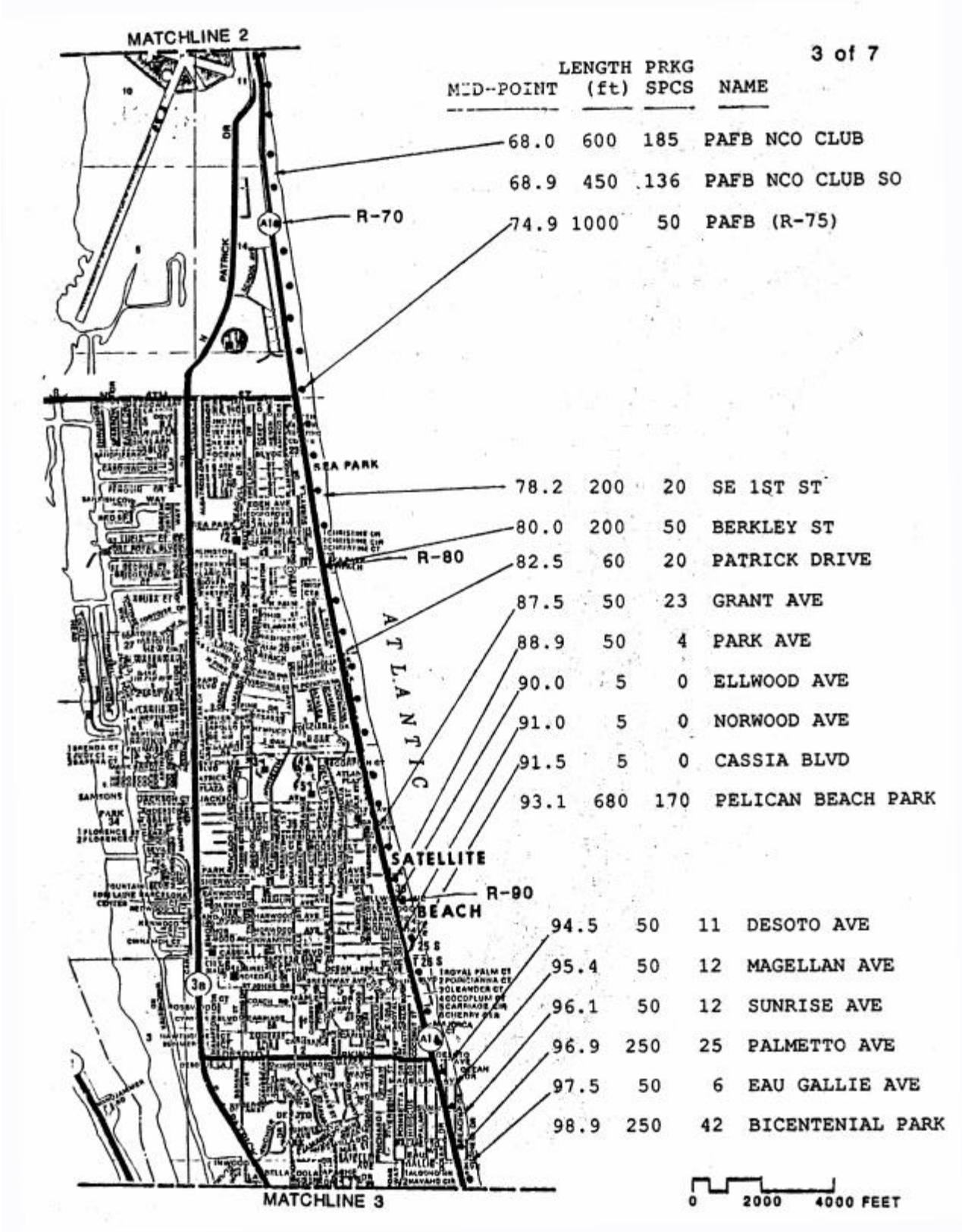


Figure B.3: Brevard County street and public beach access locations (R-065 to R-099).

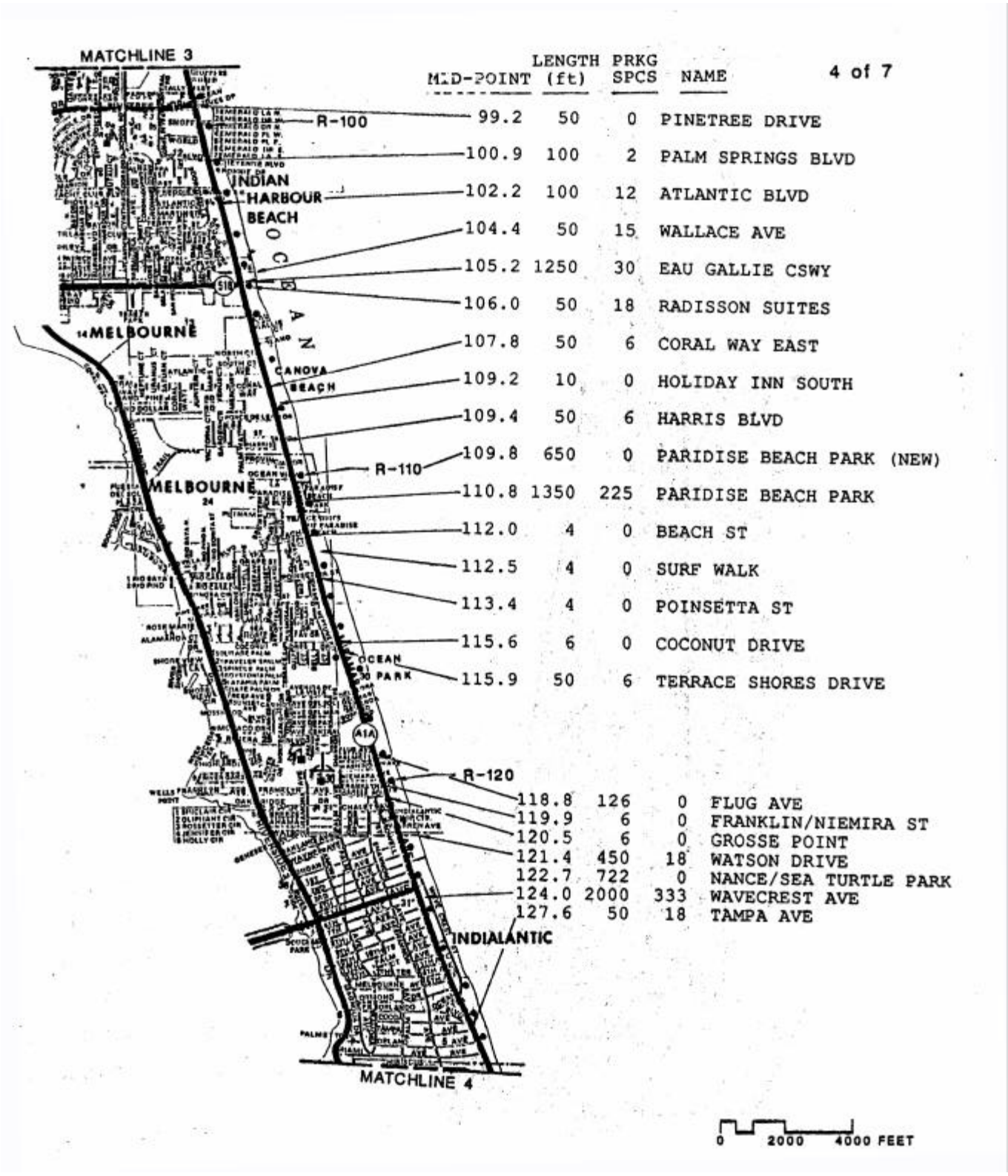


Figure B.4: Brevard County street and public beach access locations (R-099 to R-128).

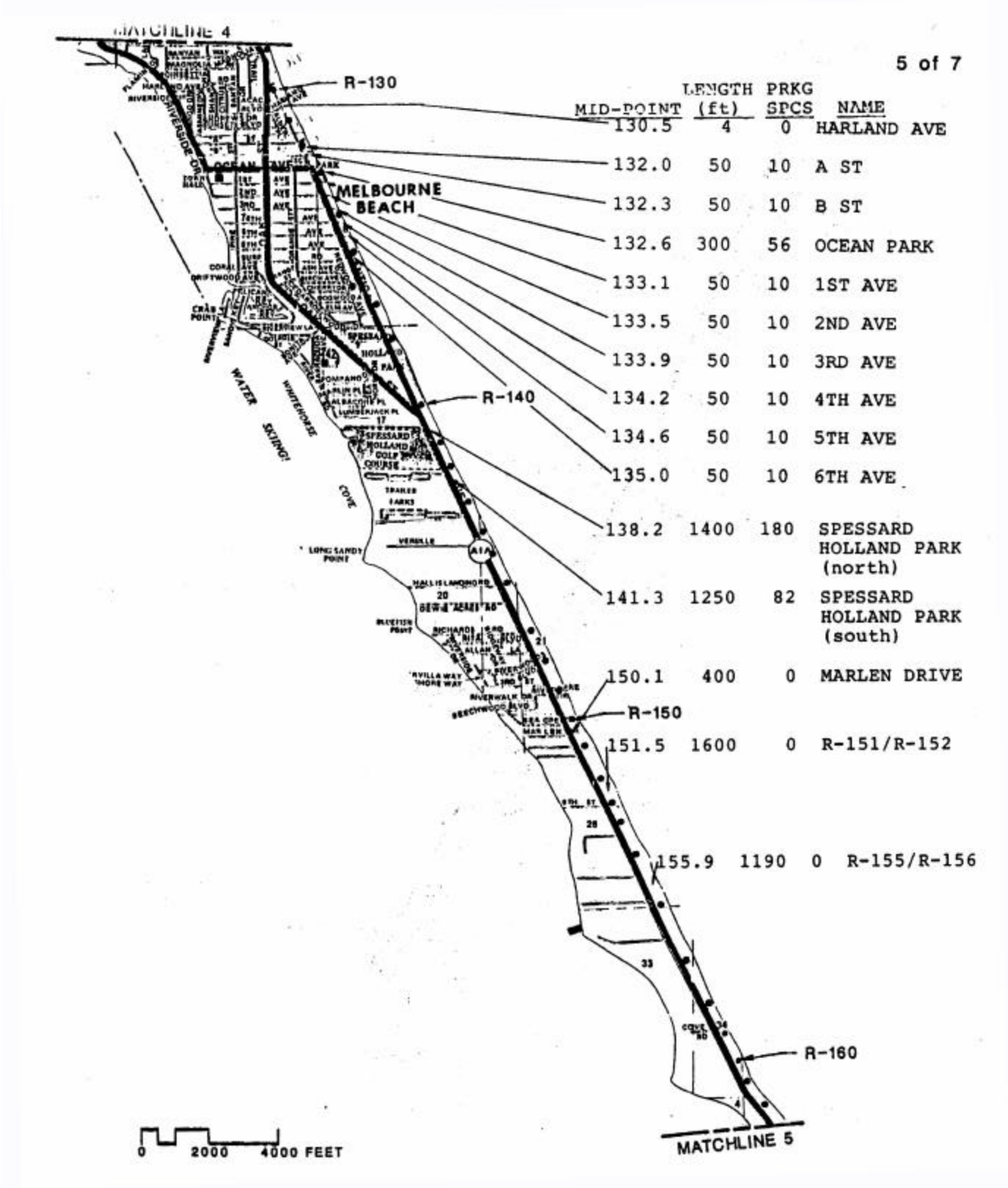


Figure B.5: Brevard County street and public beach access locations (R-130 to R-162).

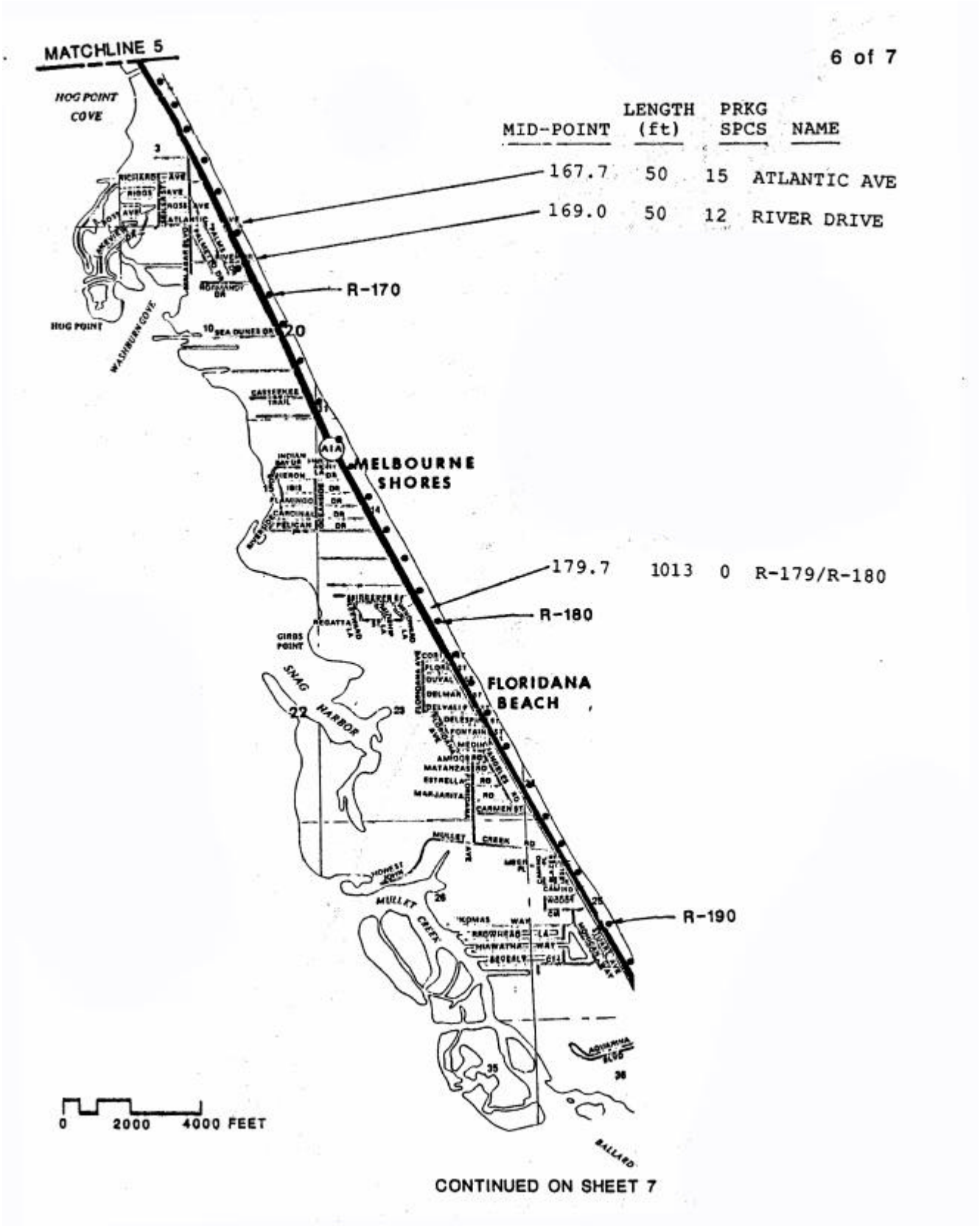


Figure B.6: Brevard County street and public beach access locations (R-160 to R-190).

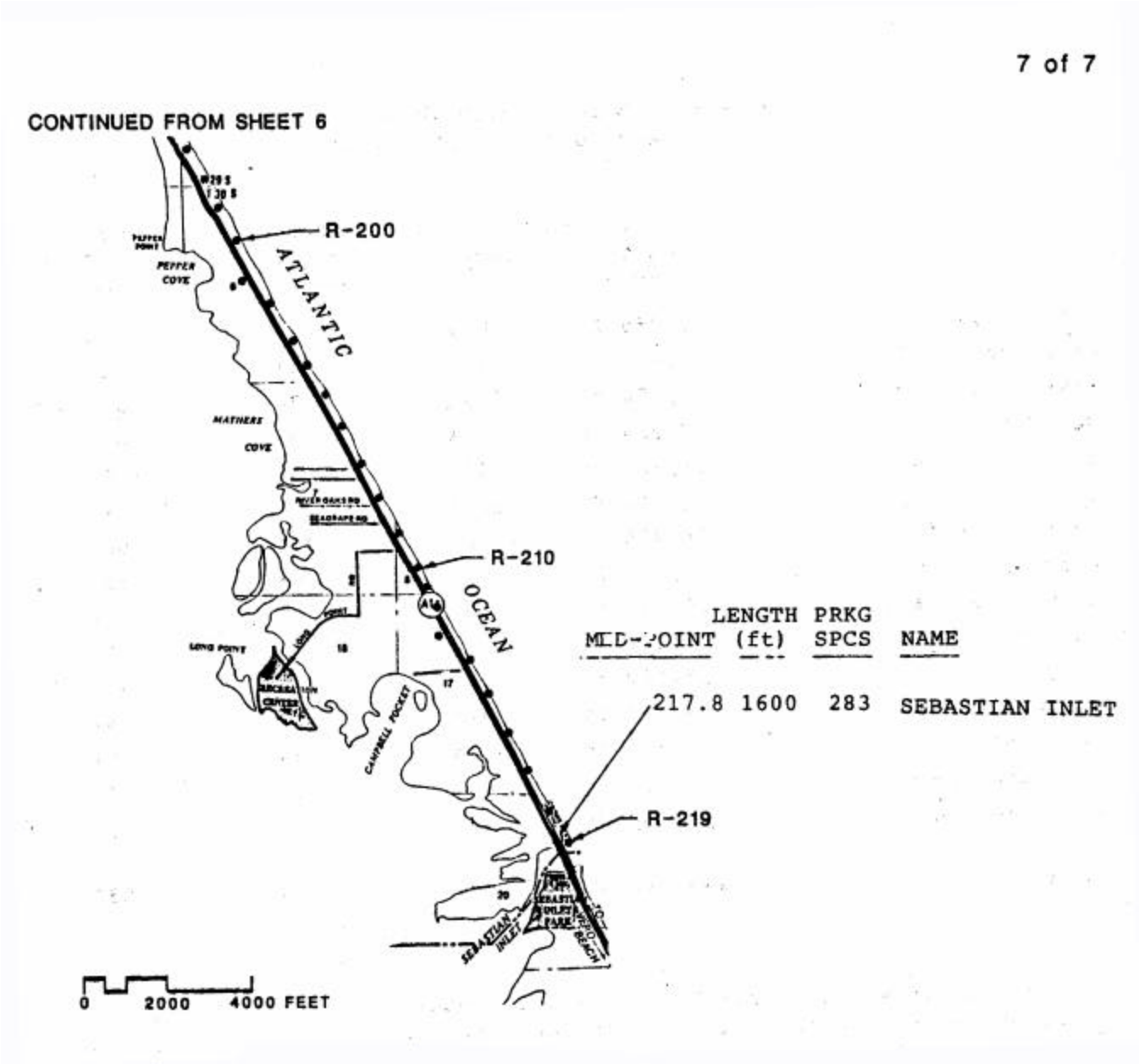


Figure B.7: Brevard County street and public beach access locations (R-197 to R-210).

APPENDIX C:

Pre-Construction Aerial Photography

This appendix contains aerial photography taken prior to construction of the South Reach project (**Figures C.1** through **C.4)**. The photography was flown in December, 2000 by the USACE. On the figures, the monitoring pre-construction (various dates – see Table A.2) mean high water line location is shown as a solid (-) blue line and the post-construction (May 2003) location as a green dashed (--) line. Also depicted in the figures are the R-monuments summarized in Table A.1.

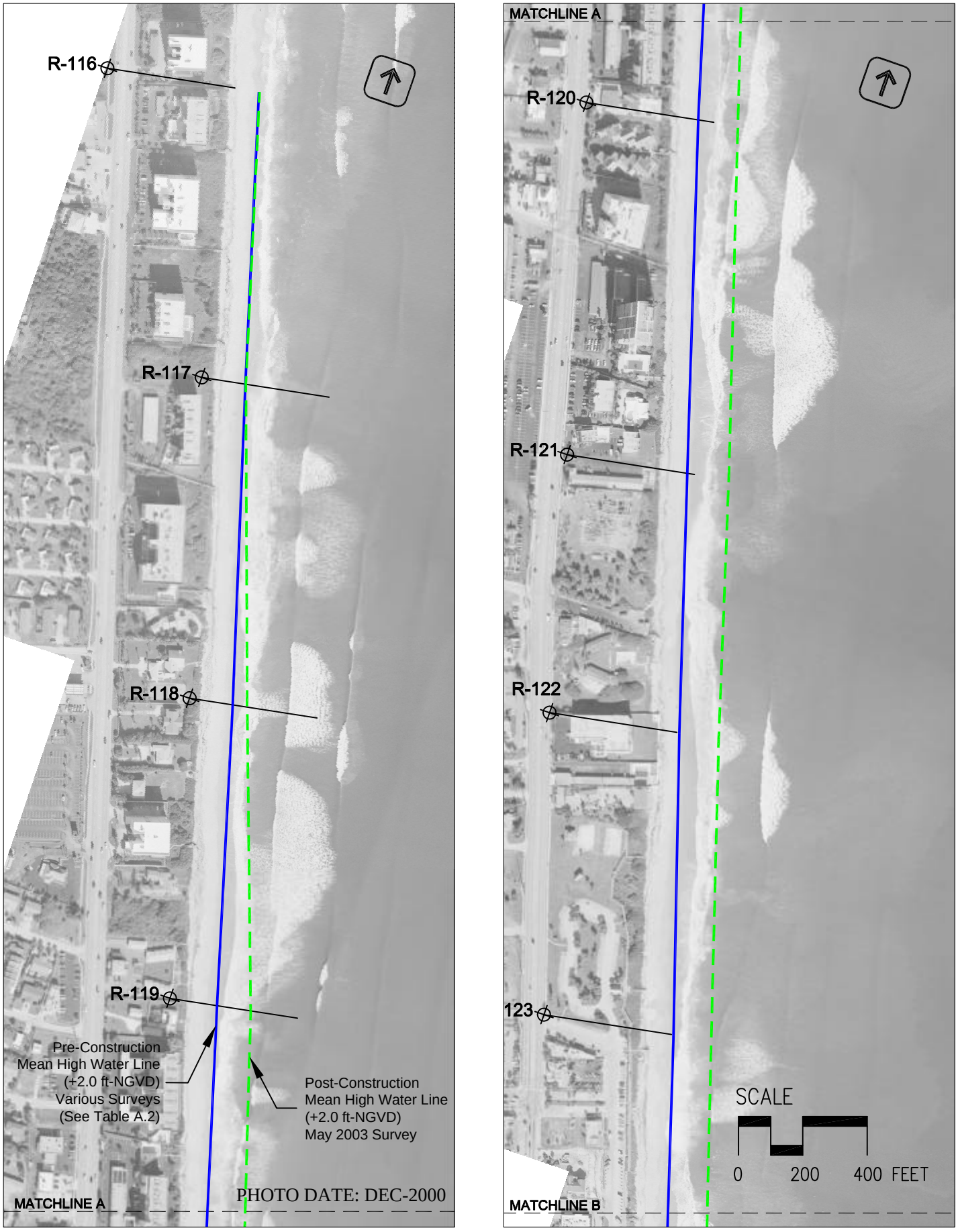


Figure C.1: Brevard County aerial photography pre-construction of South Reach project.

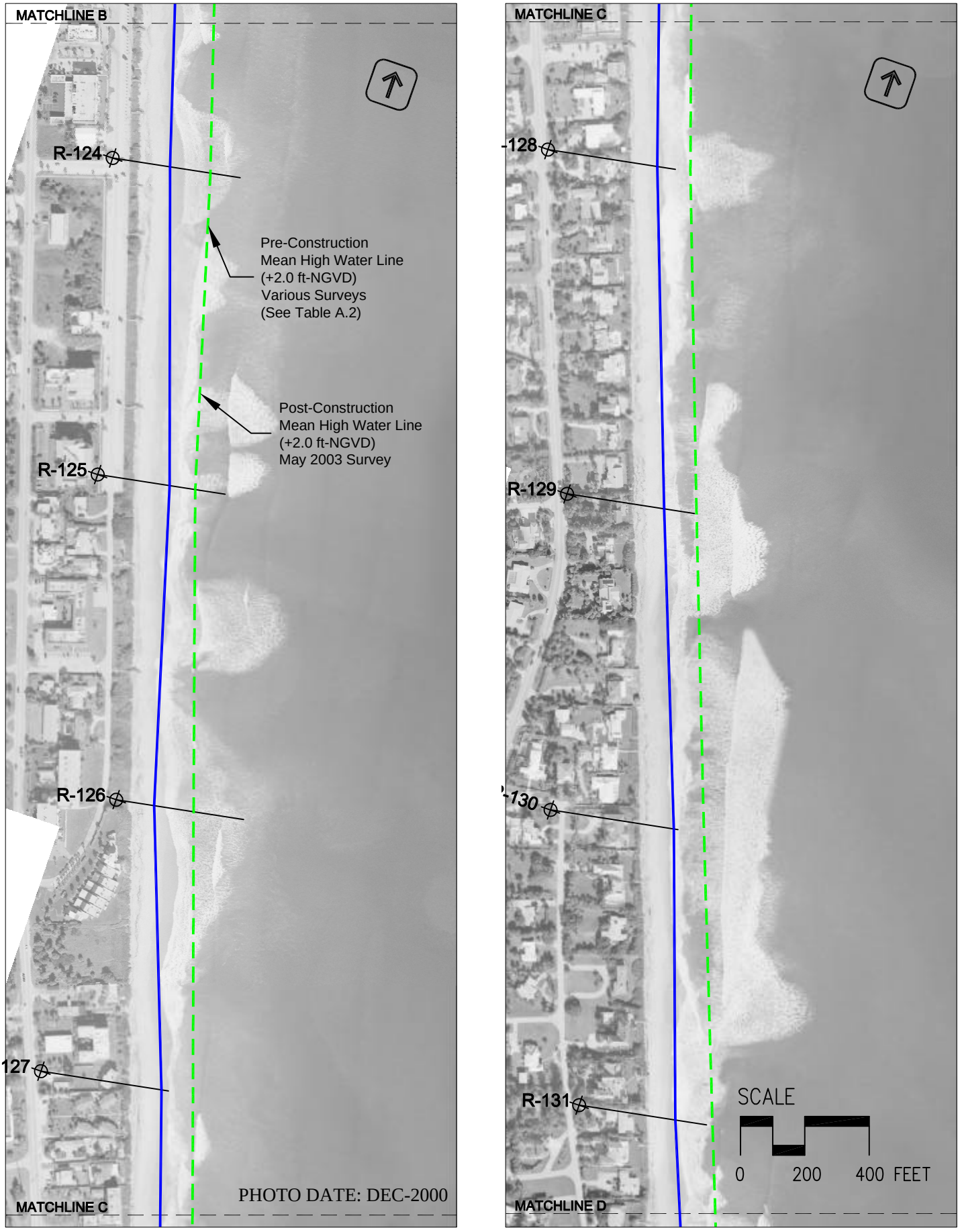


Figure C.2: Brevard County aerial photography pre-construction of South Reach project.

Figure C.3: Brevard County aerial photography pre-construction of South Reach project.

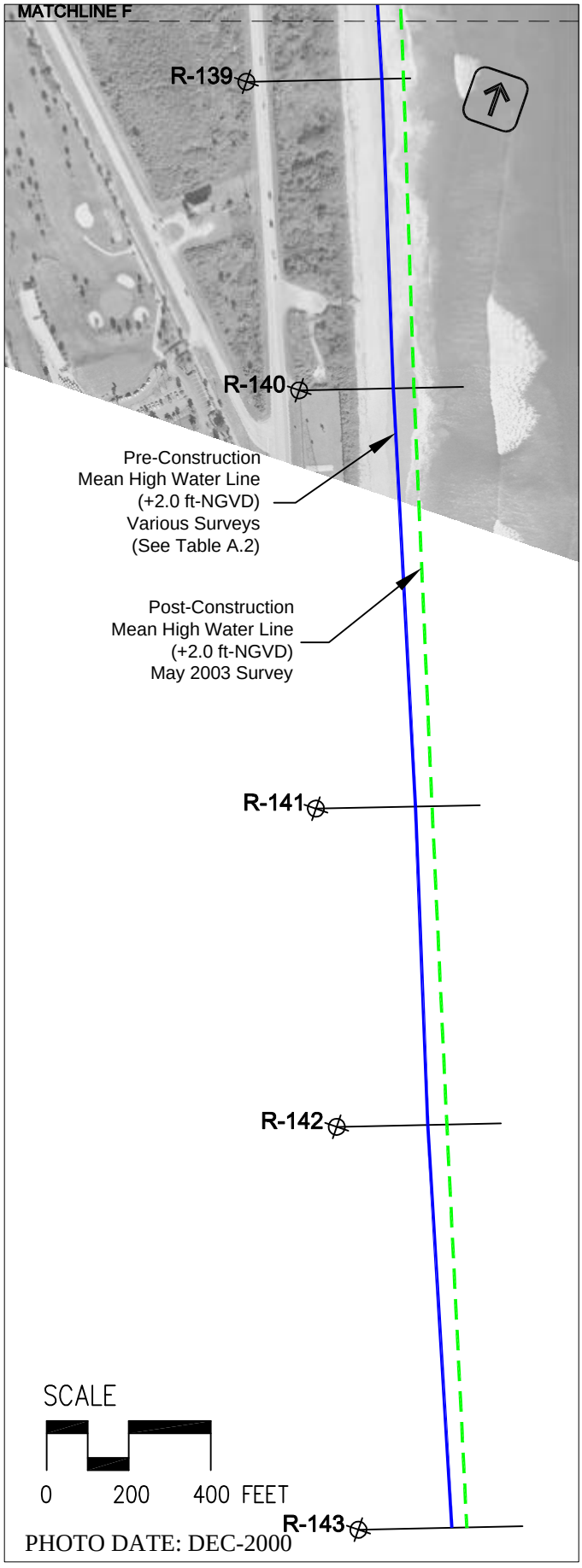


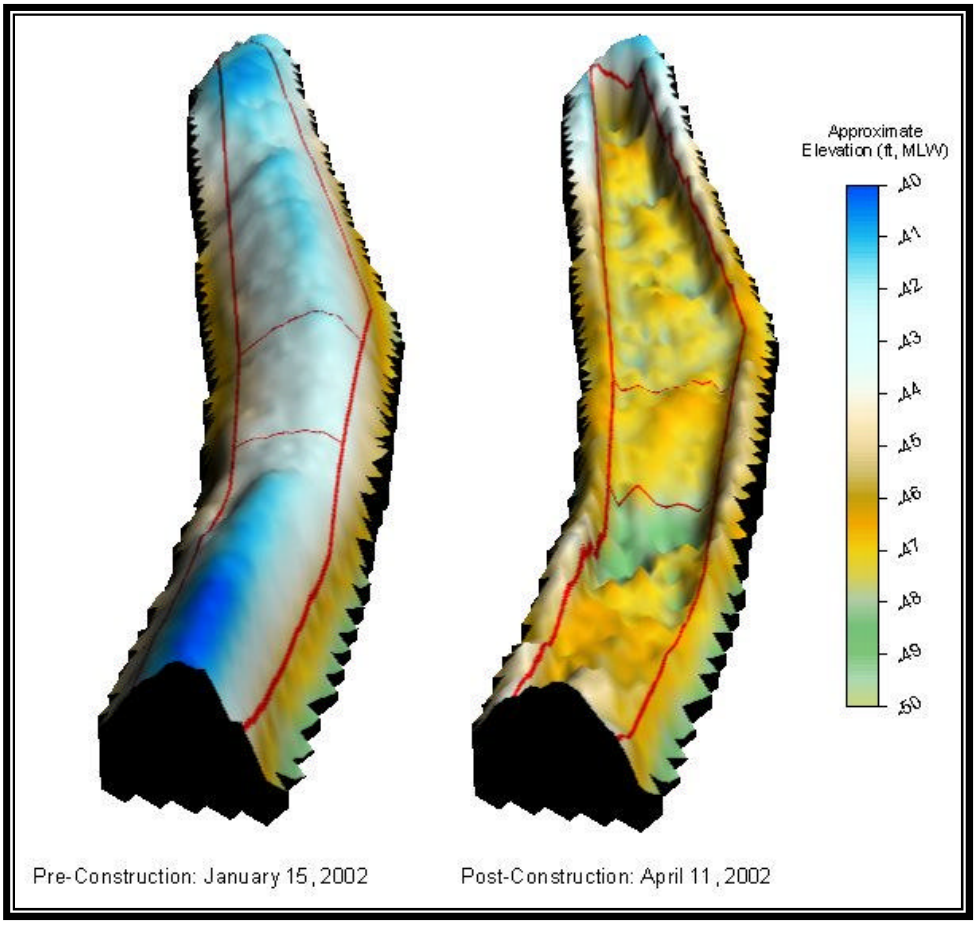
Figure C.4: Brevard County aerial photography pre-construction of South Reach project.

APPENDIX D:

Space Coast Shoals II Borrow Area Post-Construction Monitoring Report

This appendix contains the report titled "*Comparison of Pre- and Post-Construction Surveys of the Space Coast Shoals II Borrow Area, Brevard County, FL*" prepared by Olsen Associates, Inc., May 7, 2002.

Comparison of Pre- and Post-Construction Surveys of the Space Coast Shoals II Borrow Area Brevard County, Florida



Prepared for

Brevard County Natural Resources Management Office
2725 Judge Fran Jamieson Way
Bldg. A-207
Viera, FL 32940

Prepared by

Olsen Associates, Inc.
4438 Herschel St
Jacksonville, FL 32210
(904) 387-6114

May 7, 2002

Comparison of Pre- and Post-Construction Surveys of the Space Coast Shoals II Borrow Area Brevard County, Florida

Prepared by
Olsen Associates, Inc.
4438 Herschel St
Jacksonville, FL 32210
(904) 387-6114

May 7, 2002

This report summarizes volumetric changes within the Space Coast Shoals II borrow area, developed and utilized for initial construction of the Brevard County Federal Shore Protection Project South Reach in Brevard County, Florida, in accordance with FDEP Bureau of Beaches and Wetlands Resources permit number 0137212-007JC. The changes are based on January 10, 2002 pre-construction and April 11, 2002 post-construction bathymetric surveys. Great Lakes Dredge & Dock Company, the contractor for the nourishment project, conducted these surveys. **Figure 1** illustrates the location of the borrow area relative to the project shoreline.

Initial construction of the South reach project is anticipated to require about 2.1 Mcy of dredged sand. The total estimated volume requirement is comprised of beach fill (~1.6 Mcy), buffer for the South Reach Nearshore Disposal and Sand Rehandling Area (SNDSRA) (~0.25 Mcy), and approximately 0.25 Mcy of non-pay yardage and loss incurred during transport and rehandling. Two offshore borrow areas will be used to construct the work: Space Coast Shoals II and Canaveral Shoals II. The Contractor's

plan of work was to mostly or completely exhaust the supply of the former, and then move to the latter.

Space Coast Shoals II (SCS-II) is a sandy perturbation located approximately 13 miles south of Port Canaveral in water depths ranging between 42 and 52 feet. The shoal rises a maximum of 10 to 12 feet above the ambient seabed. Hopper dredging of the 182-acre borrow area commenced on January 14, 2002 and was completed on or about March 31, 2002. Excavated material was deposited in the South Reach Nearshore Disposal and Sand Rehandling Area (SNDSRA) where it was subsequently re-excavated by cutter-head dredge for the purpose of beach construction (March 13 - April 23, 2002). **Figures 2 and 3** depict the bathymetry in the immediate vicinity of the permitted borrow limits for pre- and post-construction conditions respectively. **Figure 2** additionally details the maximum vertical cut depths associated with the permitted dredge limits**.** **Figure 4** plots the changes in seafloor elevation associated with the dredging activities.

Transects for both the pre- and post-construction surveys run roughly northwest to southeast, are spaced approximately 250 ft apart, and contain a recorded depth about every 5 ft. Volume estimates were computed through mathematical comparison of surface models produced on a 10,300 ft (cross-shore) by 9,200 ft (alongshore) Cartesian grid using 100-ft cell spacing. The survey data suggest that approximately 1.32 Mcy of sediment were dredged from within the permitted limits of Space Coast Shoals II. Analysis of the net volumetric change within the entire survey area suggests a net total change (loss) of approximately 1.41 Mcy following excavation. This agrees with the

Contractor's estimated total dredge production for SCS-II, which was on the order of 1.4 Mcy. The difference between survey-wide volume estimates (-1.41 Mcy) and losses observed within the borrow area limits (-1.32 Mcy) is likely due to either dredge activity near the perimeter of the borrow area limits or slumping of the borrow area perimeter following dredging. Contractor observations support the latter, suggesting that dredging induced slope adjustment of the adjacent seabed sand into the borrow area limits, with this material subsequently dredged from within permitted limits and placed in the rehandling area.

Figure 5 presents profile section views of the borrow area for both bathymetric surveys (section locations shown in **Figure 3**). The data indicate that significant volume changes do not extend farther than 100 feet beyond the permitted horizontal limits. Within this 100-ft boundary area, average post-dredge vertical change is about 2 ft or less.

Figure 6 contrasts the permitted and after-dredge vertical excavation limits. On the whole, excavation depths along the borrow area were adhered to, or were shallower than, permitted guidelines. However, within the central, –47ft, MLW sub-boundary, excavation exceeded the allowable maximum by 12-inches or less, with the average cut about 6-inches deeper than the –47ft, MLW limit. Because the permitted cut limits were conservatively established using a 2-foot buffer set above less desirable material, no non-beach compatible material appears to have been excavated as a result. No occurrence of non-compatible material was observed within the dredge hopper or the beach fill. Core

samples C-8 and C-11 in this area indicate shelly sand (SP) extending from the seabed to an elevation of –51.1 feet, MLW and –49.5 feet, MLW respectively; or 1.5 to 2 ft deeper than the excavation grade.

As of April 2002, the Space Coast Shoals II borrow site should be considered completely developed (utilized) based upon available geotechnical data. In total, excavation of the borrow area yielded approximately 1.41 Mcy of beach quality sediment, which were placed in the SNDSRA and later rehandled by cutter head dredge for placement within the south reach nourishment project. Dredging for the remainder of the initial construction of the south reach project continued at the Canaveral Shoals II (CS-II) sand borrow area. Dredging was completed for this season on April 3, 2002 and is scheduled to re-commence after October 1, 2002 to complete initial construction of the south reach.

Figures follow:

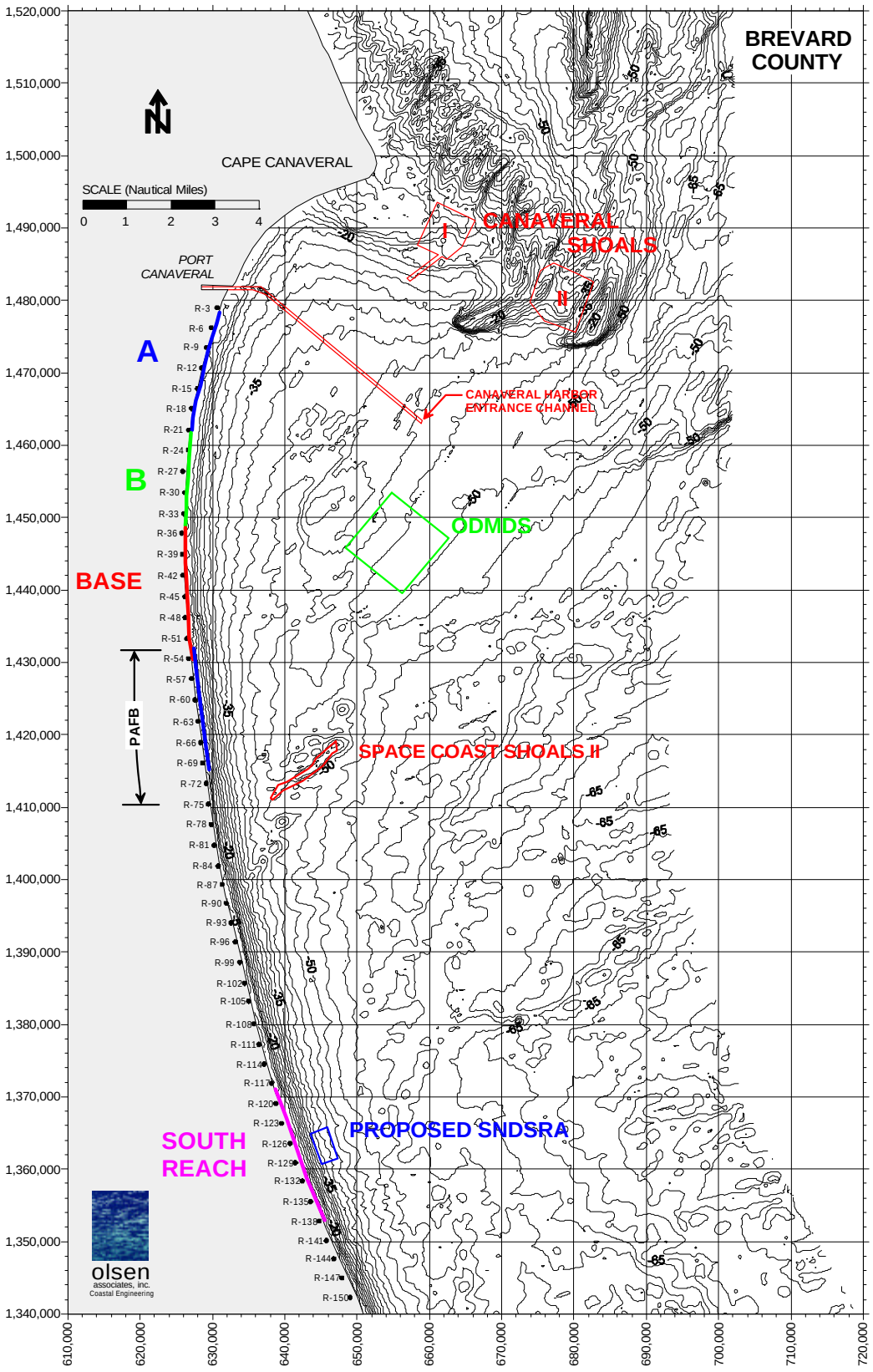


Figure 1 – General location map

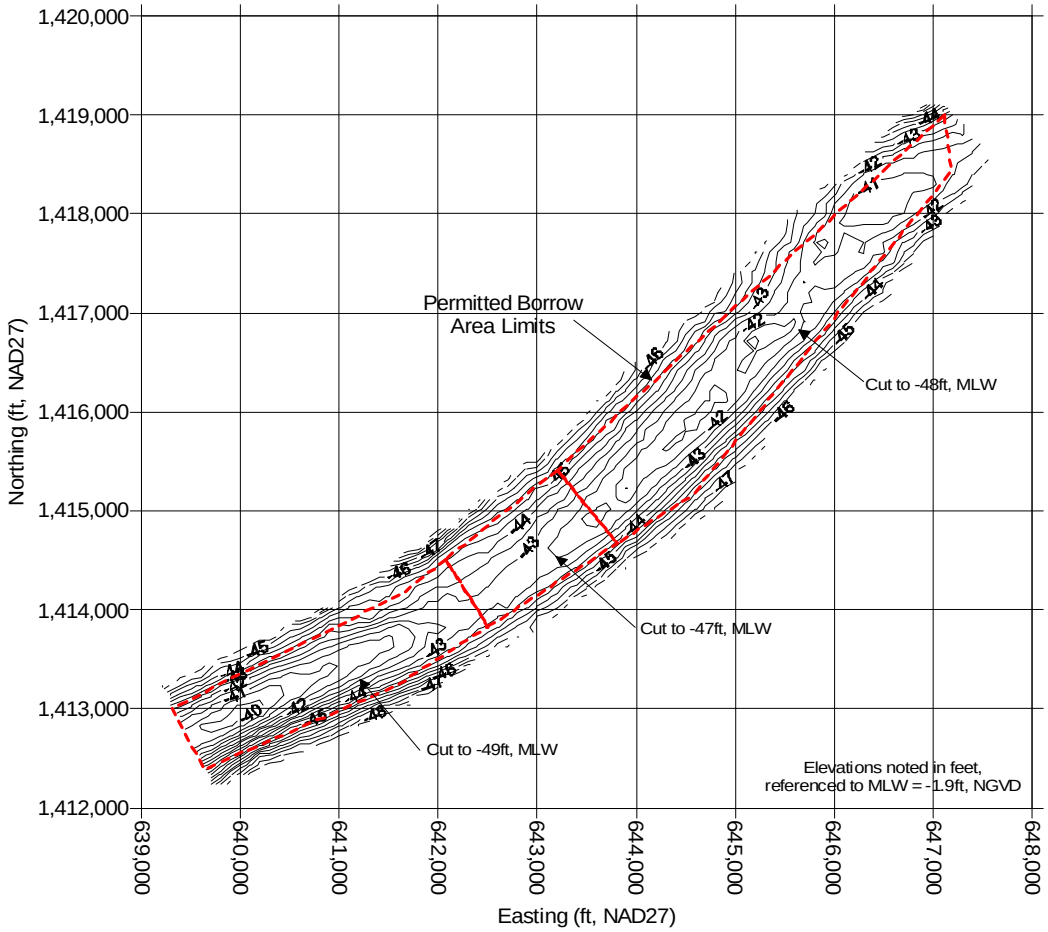


Figure 2 – Pre-construction bathymetry and permitted borrow limits. Survey conducted by Great Lakes Dredge and Dock Company January 10, 2002.

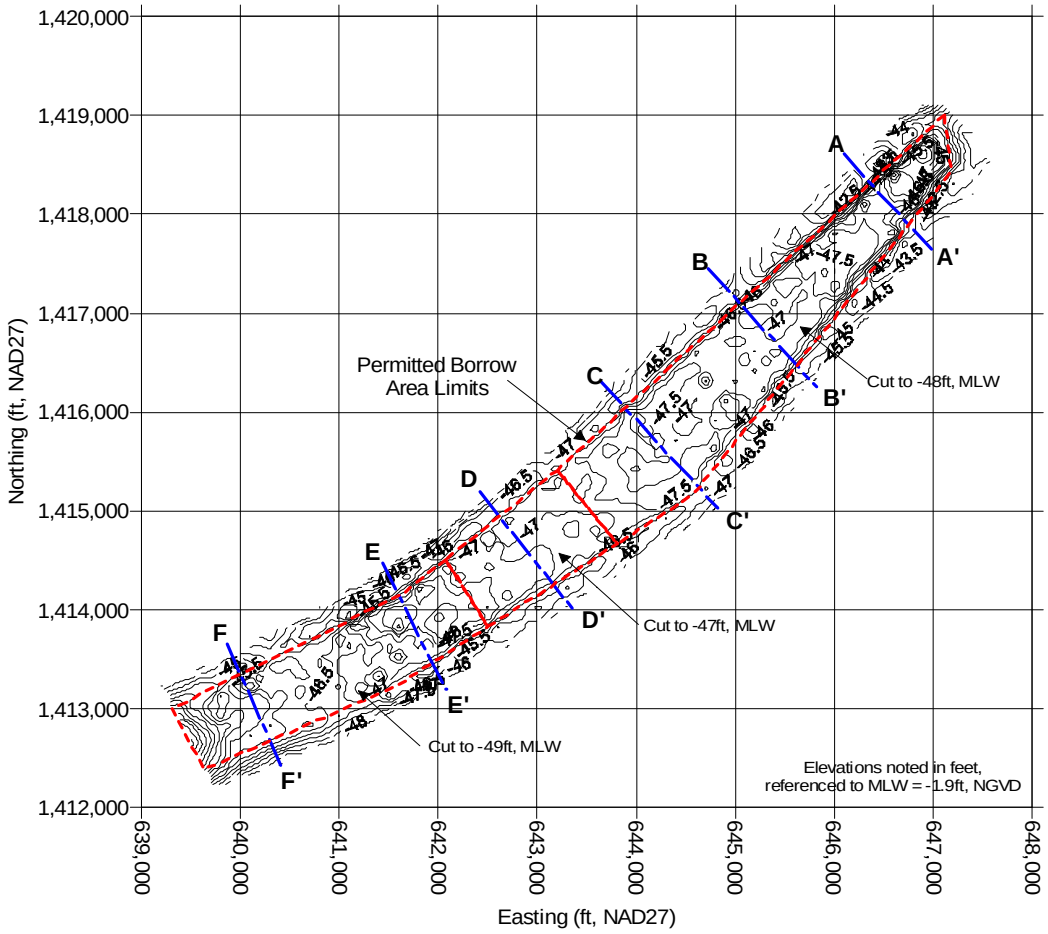


Figure 3 – Post-construction bathymetry and reference section locations. Survey performed by Great Lakes Dredge and Dock Company, April 11, 2002.

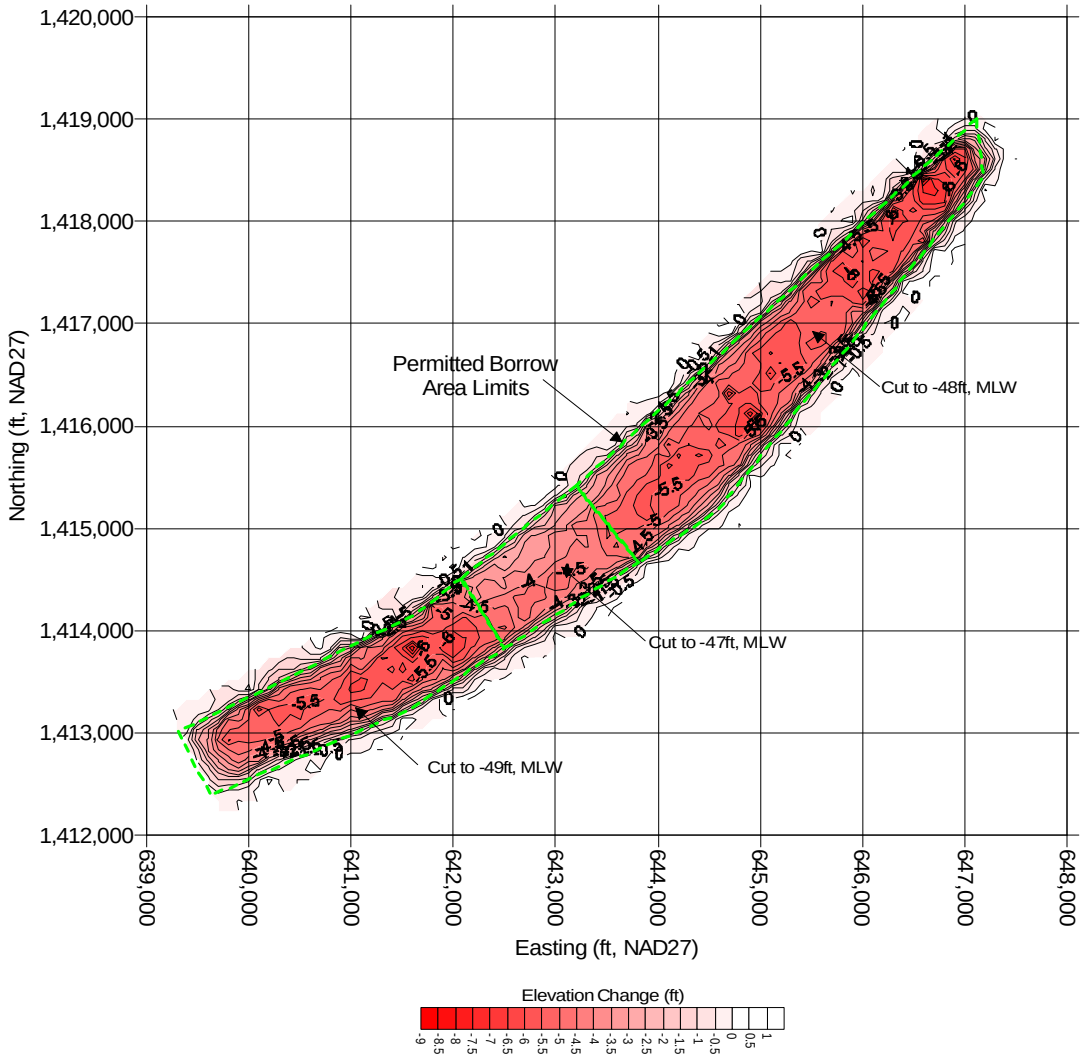


Figure 4 – Bathymetric change following dredging operations.

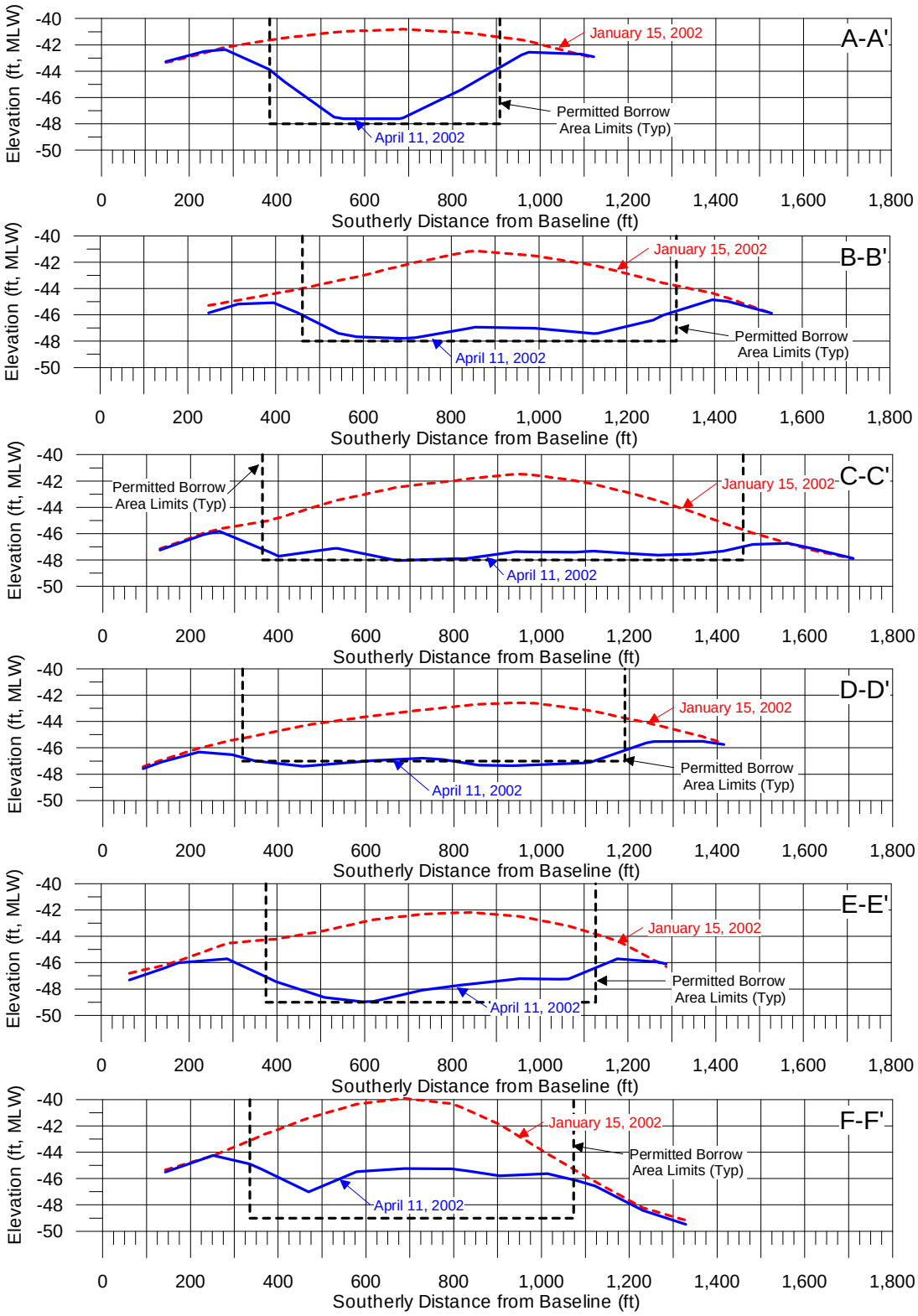


Figure 5 – Sectional views of borrow site both before and after excavation. Surveys performed by great Lakes Dredge and Dock Company. MLW is 1.9ft below NGVD.

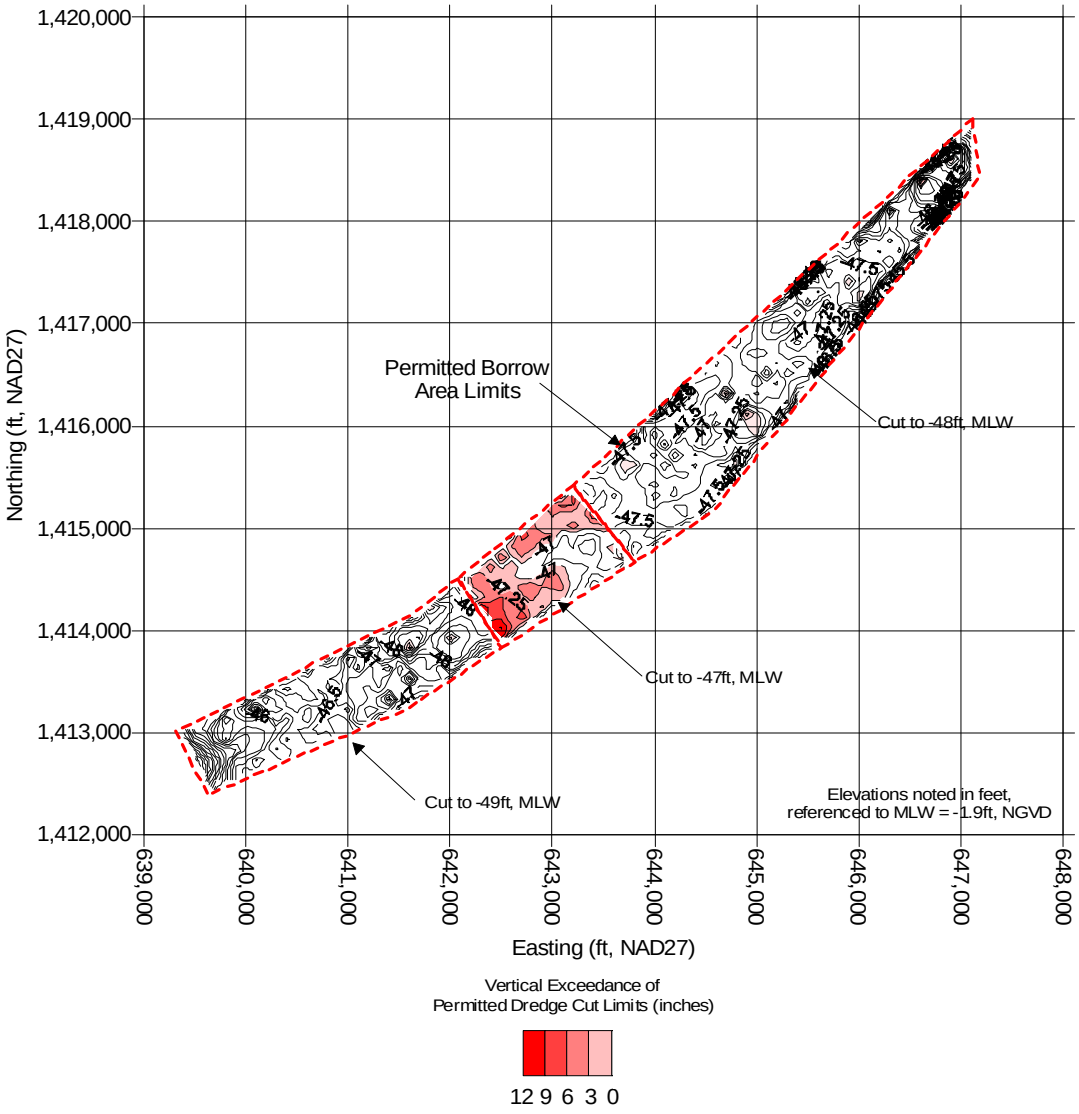


Figure 6 – Post-construction survey detailing locations where the measured dredge cut exceeded allowable maximum vertical dredge limits. Survey performed by Great Lakes Dredge & Dock Company April 11, 2002.

APPENDIX E:

Canaveral Shoals II Borrow Area Post-Construction Monitoring Report

This appendix contains the report titled "*Comparison of Pre- and Post-Construction Surveys March 2003 through May 2003 and Summary of Dredging Activity of the Canaveral Shoals Borrow Area II (CS-II) – Brevard County Federal Shore Protection Project*" prepared by Olsen Associates, Inc., June 2003.

Comparison of Pre- and Post-construction Surveys
March 2003 through May 2003
and
Summary of Dredging Activity from 2000 to 2003

of the

Canaveral Shoals Borrow Area II (CS-II)

Brevard County Federal Shore Protection Project

Prepared By:
Steven C. Howard, P.E.
Olsen Associates, Inc.
Jacksonville, FL
(904) 387-6114

June 23, 2003

Between December 2000 and May 2003, an estimated 5.2 Mcy of sand were dredged from within the Canaveral Shoals II borrow area (CS-II). The sand was utilized for beach nourishment of Brevard County, Florida in conjunction with the Brevard County Federal Shore Protection Project and along Patrick Air Force Base, Florida. Use of the dredged material from CS-II for construction of the Brevard County Federal Shore Protection Project was in accordance with the U.S Department of Interior, Minerals Management Service (MMS), Lease No. OCS-A-0454 with Brevard County, Florida. Use of material dredged from CS-II for construction of beach fill along Patrick Air Force Base, Florida was in accordance with the Memorandum of Agreement between the MMS and the 45th Civil Engineer Squadron, U.S. Air Force (7 December 2000). **Figure 1** presents a location map detailing relevant project features.

The Brevard County Federal Shore Protection Project was constructed by the Corps of Engineers as two separate beach fill contracts: the North Reach and the South Reach (see **Figure 1**). The Patrick AFB beach fill was constructed separately by the U.S. Air Force. Bathymetric changes within CS-II resulting from dredging associated with

construction of the North Reach (October 2001 – April 2001) and Patrick AFB (December 2000 – April 2001) beach fill projects have been previously analyzed[1].

Nourishment of the South Reach project was completed in two construction phases to ensure compliance with laws prohibiting hopper dredging during marine turtle nesting season: (1) between January 2002 and April 15, 2002, and (2) between March 28, 2003 and April 26, 2003. Almost all of the sand for the first phase of construction was dredged from another borrow area in State Waters, with a relatively small volume (40,000 – 50,000 cy) dredged from CS-II. Monitoring of the initial phase of South Reach construction is presented as an interim-monitoring report, attached as **Attachment A**, which was completed by Olsen Associates, Inc in June 2002. The following focuses on CS-II borrow area changes attributable to the second phase of dredging activity completed for South Reach construction, March 2003 to May 2003.

South Reach Construction (March 2003 to May 2003)

Volumetric changes within CS-II were computed by comparing pre- and post-construction bathymetric surveys of the borrow area. The 2003 survey data were collected by the dredge contractor, Great Lakes Dredge & Dock Company, and are as follows:

- March 23, 2003 (Pre-construction)
- May 2, 2003 (Post-construction)

Figures 2 and **3** respectively plot the pre- and post-construction bathymetries within the CS-II borrow area limits. All elevations are reported in feet relative to the Corps Mean Low Water datum (MLW), which is 1.9 feet below NGVD29. Horizontal control is referenced in feet to State Plane Coordinates, Florida East Zone, NAD27. The pre-

[1] Olsen Associates, Inc. (2001). "Comparison of Pre- and Post-Construction Surveys: September 2000 through April 2001 of the Canaveral Shoals Borrow Area II (CS-II). Brevard County Shore Protection Project and Patrick AFB Beach Nourishment." Submitted to Brevard County NRMO and FDEP.

construction survey covers all of the areas dredged to date, but does not include the far northwest edge of the permitted limits.

For all relevant surveys between 2000 and 2003, sections were taken through the contoured data along the northeastern limit of CS-II, which has not been dredged. A comparison of the data suggests that the seabed elevations reported in the May 2003 survey are about 0.41 feet (on average) higher than all of the other available surveys. For purposes of this analysis, elevations reported in the May 2003, post-construction data were shifted downward by 0.41 feet.

Changes in seafloor elevation are presented in **Figure 4** for the period of interest, March 23, 2003 to May 2, 2003, after the 0.41 ft shift. Comparison of the data suggests that the entire survey area experienced a net volume loss on the order of 430,125 cy during the monitoring period. This reflects 592,475 cy gross *loss* and 162,350 cy gross *gain*.

According to the Contractor, dredging activity was limited to the southern portion of CS-II specifically along the southeastern edge of the permitted borrow area limits. The extent of the 2003 dredging operation (about 161 acres) is relatively small compared with the overall borrow area, which covers about 1,200-acres. In order to better estimate the dredge-related volume change for this monitoring period, the immediate vicinity of the excavation was computed (see area of interest in **Figure 4**). The data indicate a gross decrease (loss) of approximately 287,500 cy of sand over the March-May 2003 period within the area of interest. This computed volume is smaller than the final haul volume estimate provided by the Contractor (384,081) and smaller than the pay volume computed by the U.S. Army Corps of Engineers (324,686 cy).

A comparison between the May 2003 post-construction survey and the January 2002 dataset, capturing both seasons of South Reach dredging activity suggests that the area of interest detailed in **Figure 4** experienced a net loss on the order of 417,570 cy (17,190 cy *gain* – 434,760 cy *loss*). This change could represent natural sediment

transport patterns in the vicinity of CS-II, or the post-dredge slumping of the adjacent sediment into the borrow area followed by subsequent dredging of the reposed sediments. However, the orientation of the 2002 survey transects makes direct comparison with the post-construction 2003 data unreliable and the findings cannot be verified. It is likely that some of the dredged sand volume along the southeast boundary of the borrow area is not well discriminated by the surveys.

Figures 5 and **6** present section views of the borrow area for the most recent monitoring period. The locations of sections A-A', B-B', and C-C' are consistent with previous monitoring studies. No dredging activity was reported along these section areas, and the data indicate no significant changes in seafloor bathymetry. Section D-D' passes though the area of interest and details the 2003 dredge cut. The maximum cut in the area of interest was approximately 10 feet below pre-construction grade. The maximum dredge depth was about –48 ft, MLW. Permitted depths in the area of interest are –46, ft and –48 ft, MLW. The data suggest that no dredging occurred below the permitted maximum elevations.

Project Wide Changes to CS-II (September 2000 – May 2003)

Total Dredge Volumes. **Table 1** details the measured and Contractor reported estimates of dredge production in CS-II for each project reach. The "measured" values reflect those computed by comparison of surveyed bathymetries. Between September 2000 and May 2003, between 5.1 and 5.2 Mcy of sediment were excavated from within CS-II for subsequent use in the construction of the Brevard County Federal Shore Protection Project and the Patrick AFB beach fill. The computed excavation volume differs from the Contractor and USACE estimates by approximately 122,000 cy. This difference represents less than 2.5 percent of the entire dredged volume and is considered within the range of accuracy typically expected for the scope of surveys and construction activity attendant to this project.

Table 1 – Volume changes in CS-II attributable to dredge activity, October 2000 through May 2003. Comparisons were made in the specific area(s) of dredging activity and do not consider changes to the entire Borrow Area.

Survey Date	Project Reach	Measured Dredge Volume (cy)	Reported Dredge Volume (cy)
9/2000 - 4/2001	North Reach	4,260,000	4,210,000
	PAFB	560,000	590,000
1/2002 - 4/2002	South Reach I	**	40,000 - 50,000
3/2003 - 5/2003	South Reach II	287,500	384,080
	TOTAL	**5,107,500**	**5,229,080**

** Cannot be determined:
Background change rates exceed recorded dredge volume

A direct comparison of the September 2000 (pre-project) and May 2003 (post-project) surveys -- within the overall permitted limits of CS-II -- indicates a gross overall volume loss of approximately 5.3 Mcy, gross gains of about 0.37 Mcy, for a net loss of about 4.95 Mcy for the entire project period (see **Table 2**). The gross loss estimate is very close to Contractor estimates of dredge volume (5.2 Mcy) and within the limits of reasonable survey error for a borrow site of this magnitude (1,200 acres). For example, a vertical shift of only +/- 0.2 feet in the survey data corresponds to a volume change of +/- 387,200 cy. **Figure 7** plots the change in seafloor elevation for the direct comparison between the pre-and post-project surveys. The gross volume gain over the entire project period computed in **Table 2** is periodically much higher, as indicated by the interim survey comparisons described in the following section.

Table 2 – Volumetric change within CS-II borrow area limits.

Survey Period	Project Reach	Gross Gain (cy)	Gross Loss (cy)	Net Change (cy)
9/26/2000 - 5/23/2003 Direct Computation	**TOTAL**	**371,670**	**-5,329,100**	**-4,957,430**

Discussion by Interval. Dredging for the North Reach began on October 1, 2000 and concluded in April 2001. About 4.82 Mcy of sand were removed from CS-II via hopper dredge, most of which was placed in the Nearshore Disposal and Sand Rehandling Area (NDSRA) for later transfer to shore and construction of the North Reach Project by cutter-head dredge. Between 560,000 and 590,000 cy of this initial cut

were used to construct the Patrick AFB project by direct transfer from CS-II to the beach by hopper dredge pumpout.

Between April 2001, and January 2002, there was no dredge activity within CS-II. Background changes during this interim-monitoring period were significant, however. The computed net volumetric change within the permitted borrow area limits was a gain of about + 332,350 cy. This reflects a gross gain of about 665,400 cy and gross losses of about 333,050 cy. This measured change equates to an annualized net gain of approximately 445,000 cy/yr. While current data do not allow for a reliable prediction of the CS-II recovery rate, the volumetric gains experienced by the borrow area during this monitoring period demonstrate the dynamic nature of the CS-II seabed.

Minor excavation of CS-II resumed after March 25, 2002 for initial-phase construction of the South Reach project. Construction was halted for consideration of marine turtle nesting season in April of 2002. Contractor estimates of dredge production in CS-II were between 40,000 and 50,000 cy for the March – April 2002 activity. This excavation volume is far less than the measured background transport rates observed during the interim-monitoring period making verification of the excavated volume impracticable. (See **Attachment A**) The majority of sand excavated for the South Reach in 2002 was from Space Coast Shoals II, in State Waters, totaling about 1.4 Mcy

Initial construction of the Brevard County Federal Shore Protection Project was completed in March-April 2003 with the aforementioned dredging of between 324,686 cy (pay volume) and 384,081 cy (haul volume). Comparative surveys of CS-II during this period indicate an excavation volume of about 287,500 cy.

The most recent survey data (May 2003) suggests that approximately 23.2 Mcy of sand remain within the permitted dredge limits of CS-II. **Figure 8** presents a plot of the May 2003 bathymetric survey for CS-II and the volume remaining within each permitted cut sub-section.

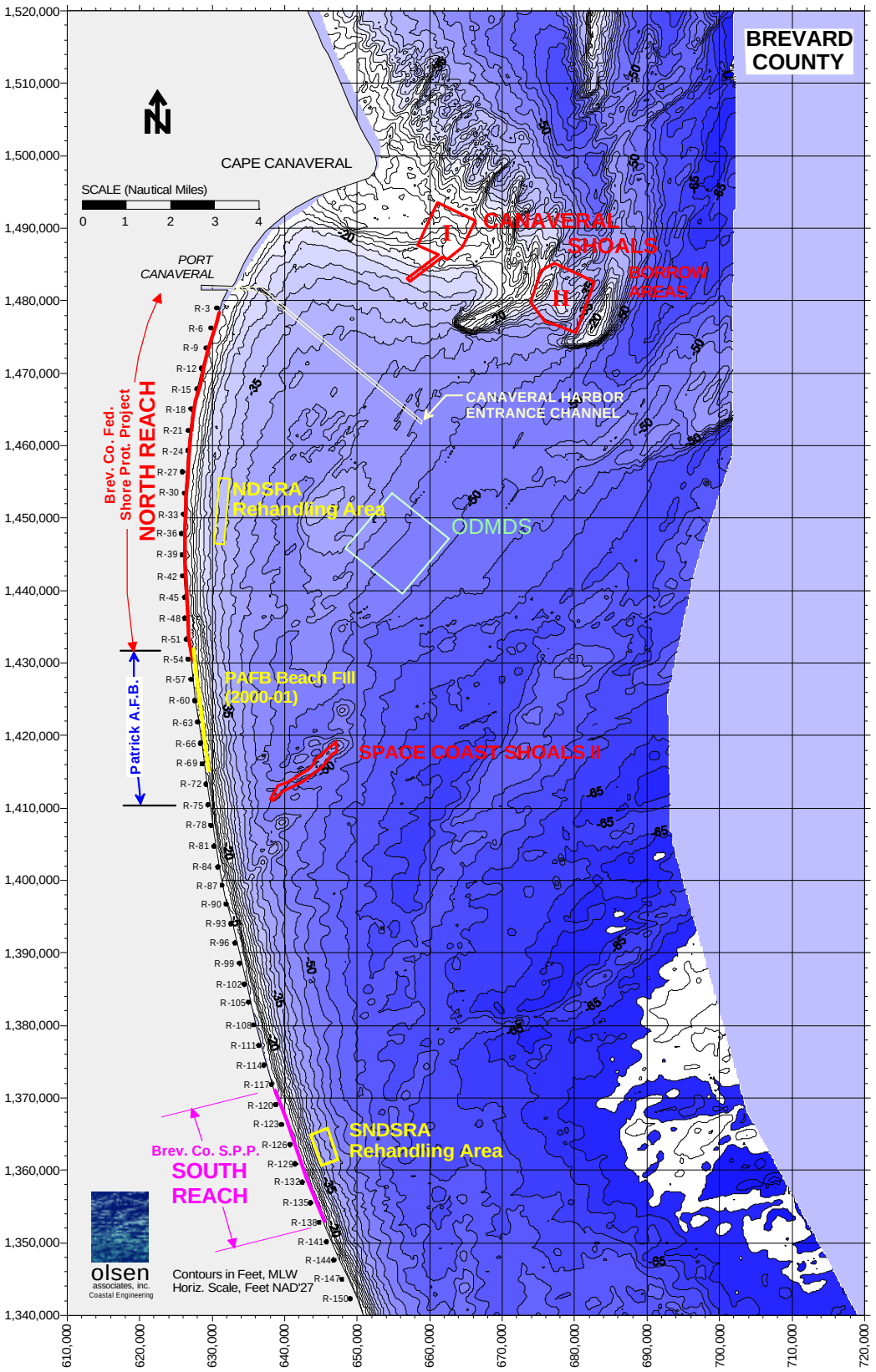


Figure 1 – General location map.

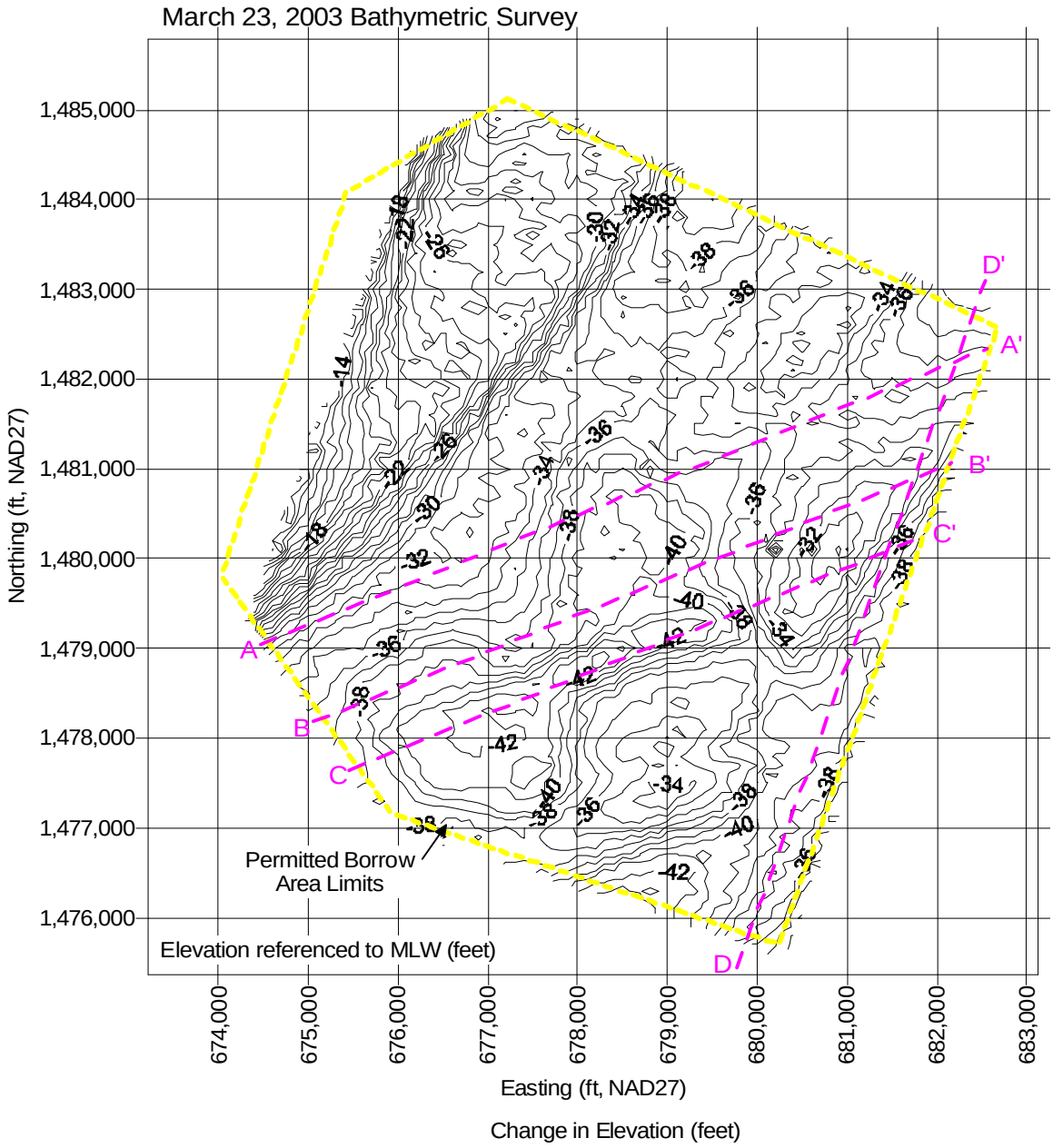


Figure 2 – March 23, 2003 bathymetric survey of the CS-II borrow area.

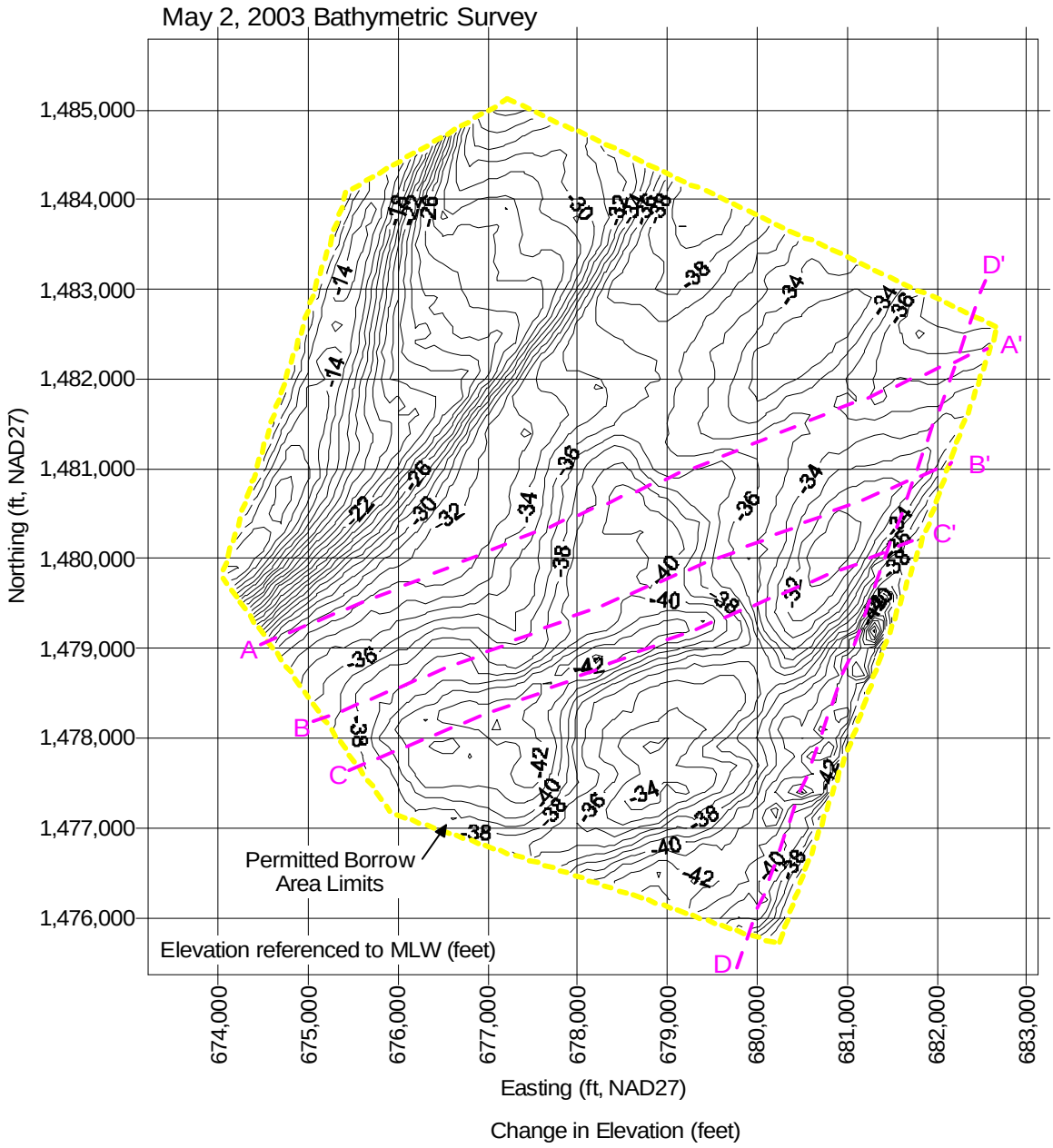


Figure 3 – May 2, 2003 bathymetric survey of the CS-II borrow area.

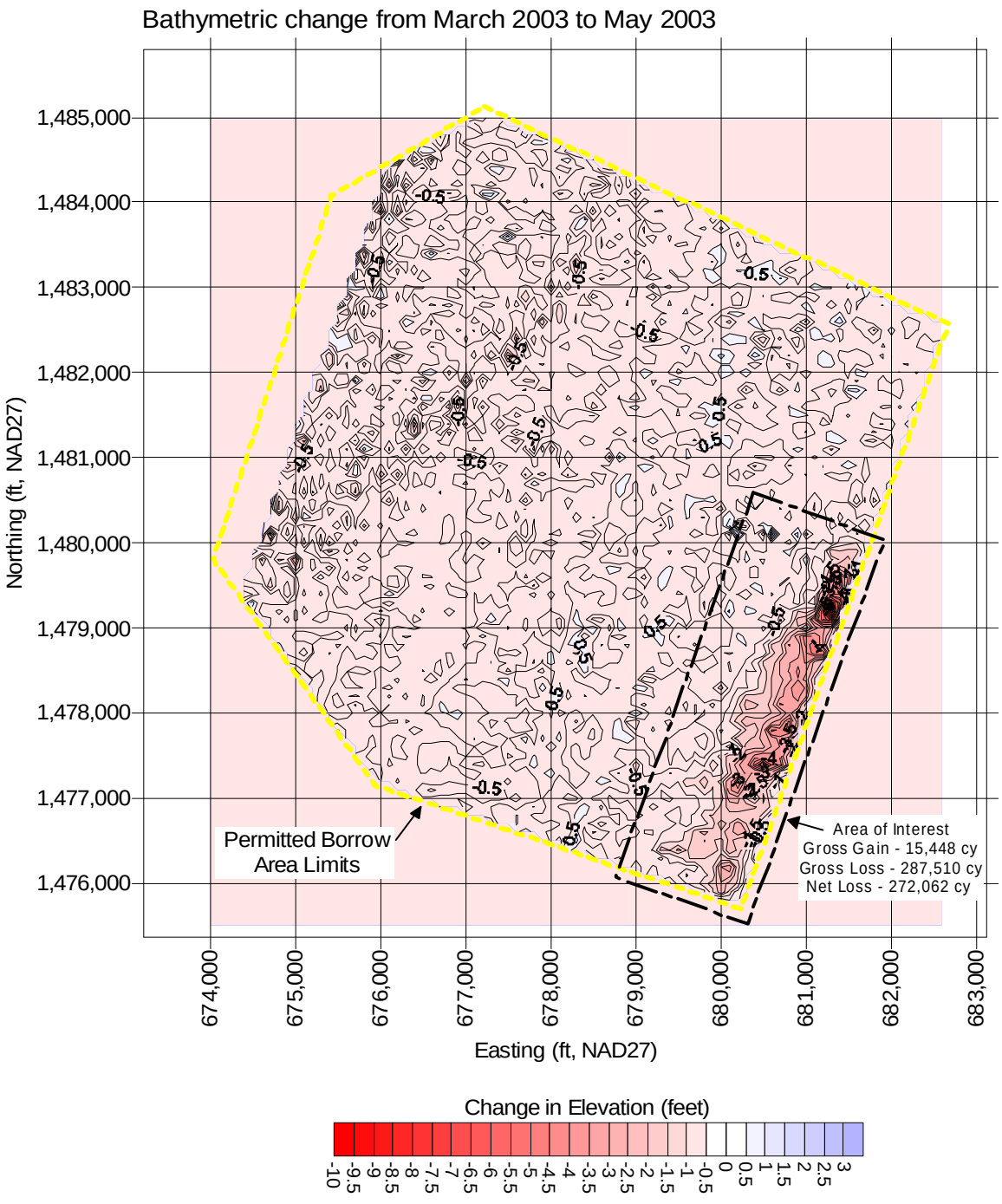


Figure 4 – Changes in seafloor bathymetry March 23, 2003 to May 2, 2003. Area of interest denotes primary region of dredging activity for this phase of construction. Volume changes shown represent those changes computed within the area of interest *and* the permitted CS-II boundary.

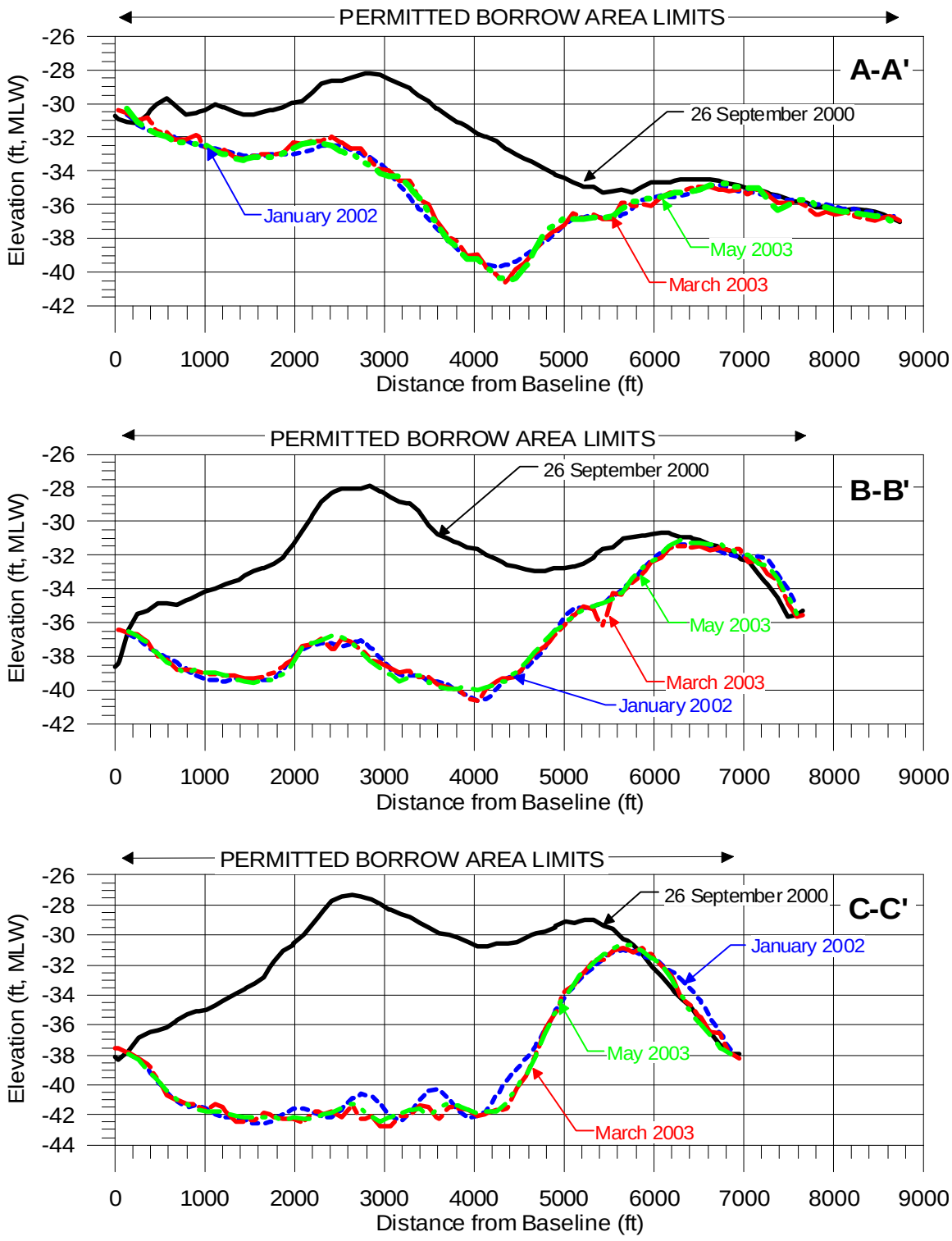


Figure 5 – Section views of bathymetric data within the CS-II borrow area (1 of 2).

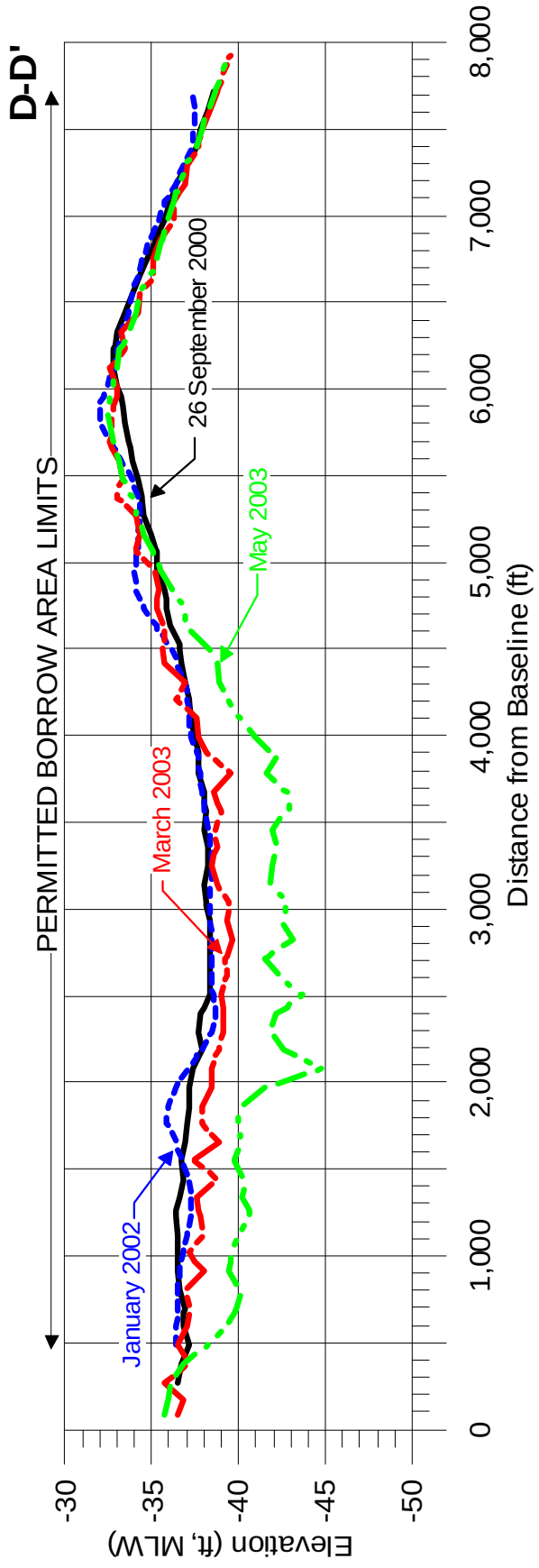


Figure 6 - Section view of bathymetric data within the CS-II borrow area (2 of 2).

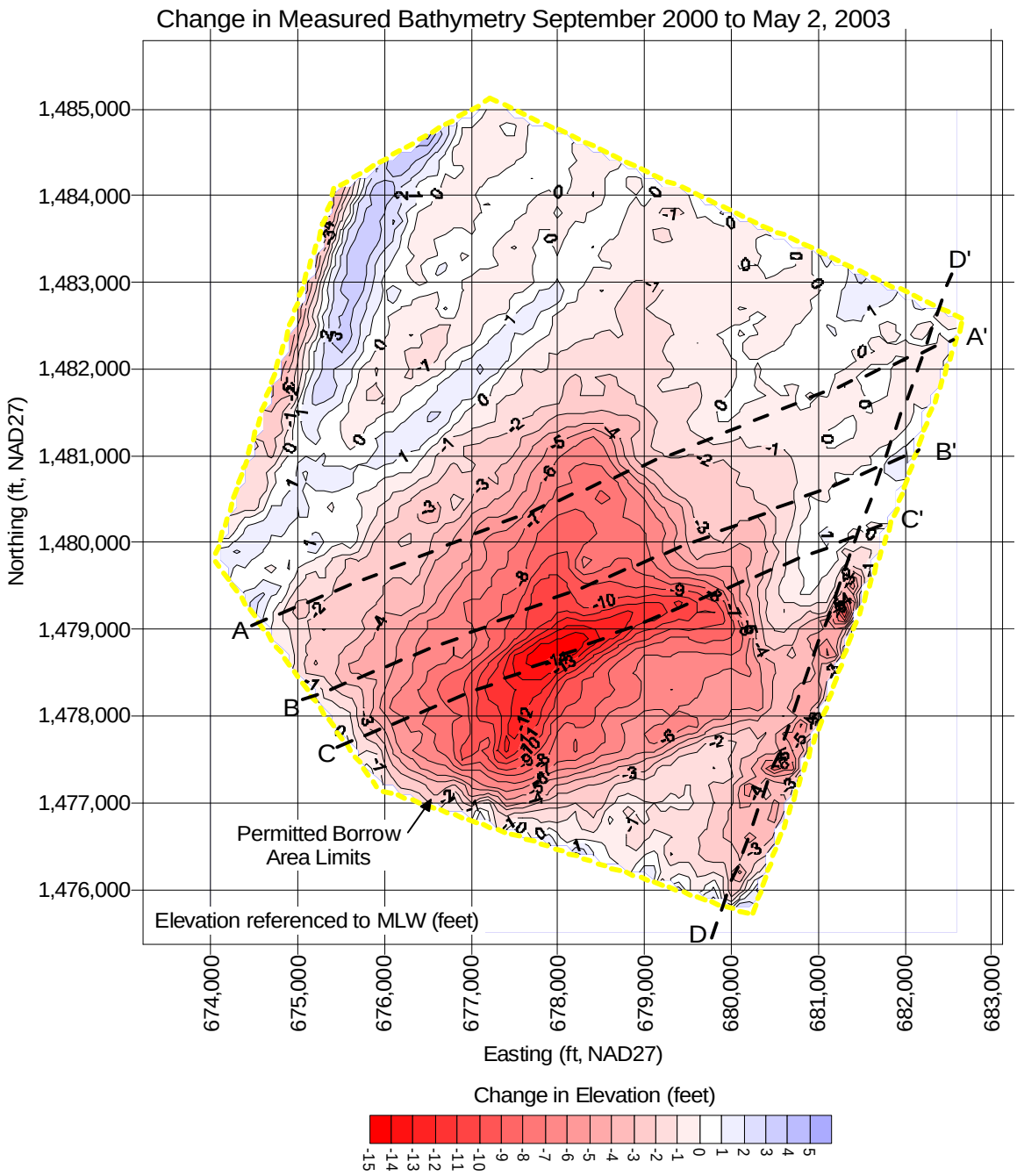


Figure 7 – Change in bathymetry between September 2000 and March 2003 (pre- to post-project conditions).

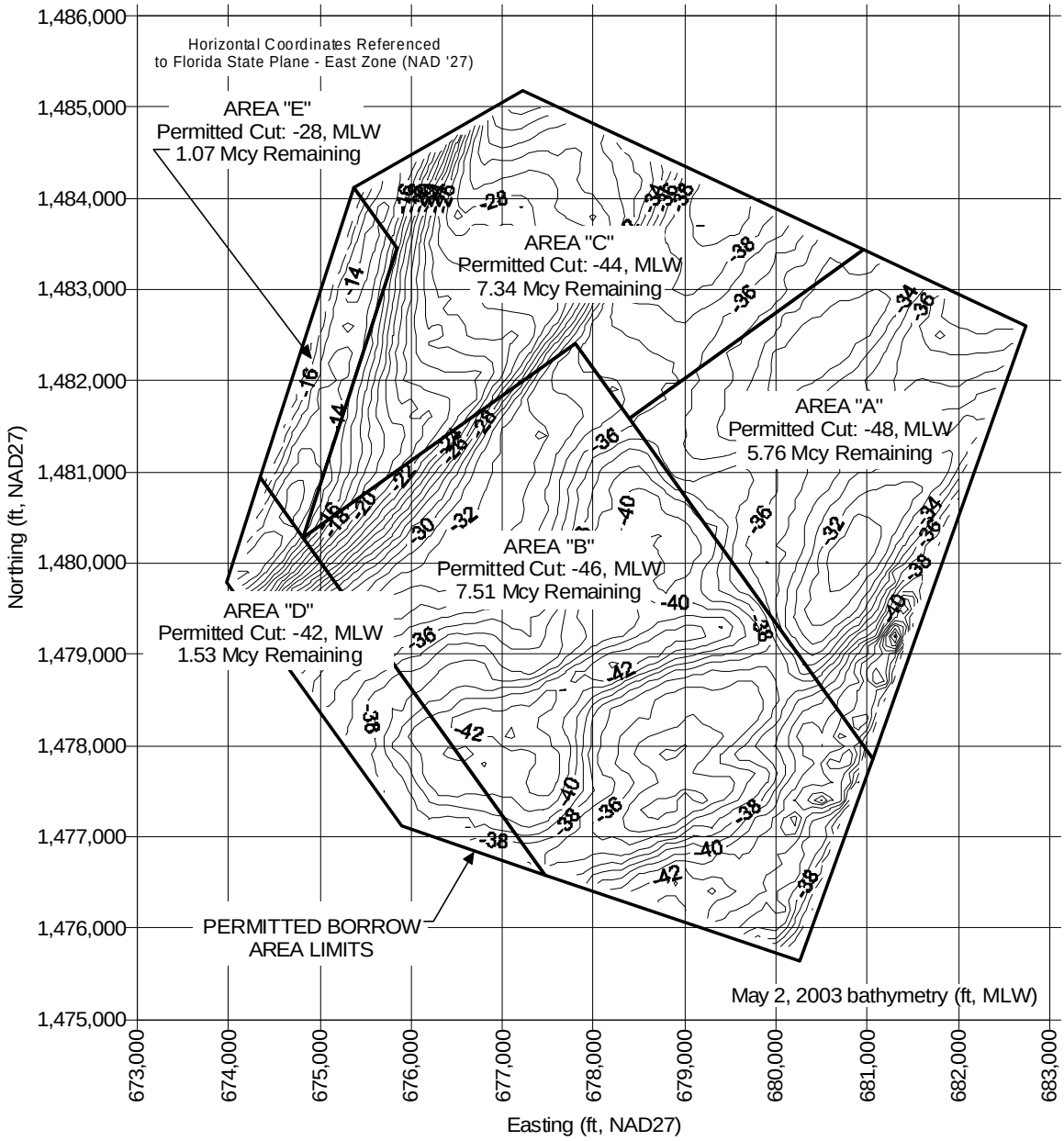


Figure 8 – Volume remaining in each of the five CS-II permitted sub-sections, as of May 2003.

ATTACHMENT A

Interim-monitoring report for CS-II borrow area, South Reach construction

MEMORANDUM

To: Virginia Barker

From: Steven Howard

Date: June 4, 2002

Cc: File

Re: South Reach - CSII Borrow Area Monitoring, Interim Report

olsen
associates, inc.
Coastal Engineering
4438 Herschel Street
Jacksonville, FL 32210
(904) 387-6114

This memorandum summarizes the volumetric changes in the Canaveral Shoals II offshore borrow area (CS-II) of the Brevard County Shore Protection Project in Brevard County, Florida, pursuant to FDEP Bureau of Beaches and Wetlands Resources permit number 0137212-005JC. The changes are based upon April 25, 2001, January 2002, and April 15, 2002 bathymetric surveys. The April 25, 2001 survey was completed following initial construction of the North Reach nourishment project. The January 2002 and April 15, 2002 surveys are pre- and post-construction surveys respectively taken in conjunction with the South Reach initial nourishment. Great Lake Dredge and Dock Company, the contractor for the nourishment project, performed each of the surveys. **Figure 1** presents a map detailing the location of CS-II and the South Reach project limits.

April 25, 2001 (post-North Reach) to January 2002 (pre-South Reach)

Figure 2 presents the bathymetric contours in vicinity of the CS-II borrow area for the April 25, 2001 and mid- to late- January 2002 surveys. There was no dredge activity in CS-II during this 9 month period; thus, the elevation changes presented in **Figure 3** illustrate the natural migration of sediment within the borrow area. The data indicate that between April 2001 and January 2002, the permitted borrow area limits experienced a net volume gain of approximately 332,350 cy. This net change is comprised of a volumetric increase of about 665,400 cy and a loss on the order of 333,050 cy.

During the same time period, the portion of CS-II principally affected by dredging for the North Reach nourishment project (see **Figure 3**) realized a total volume increase of about +340,200 cy and a loss of -146,500 cy (193,700 cy *net* increase). This equates to about +260,000 cy/yr net increase.

The cut made in CS-II during construction of the North Reach project is also detailed in **Figure 3**. The line weight of these contours is pictured in black and has been scaled according to cut depth. These lines represent the vertical extent of dredging conducted in CS-II for the North Reach and PAFB beach nourishment projects from October 2000 to Early April 2001. The survey data indicate that recovery has taken place in the vicinity of the deepest dredge cuts (thickest contour lines). It is unclear whether this recovery is due to sediment readjustment within CS-II and/or is additional sand which was transported into the borrow area from either the northwest or northeast via the expansive surrounding shoal system (see **Figure 1**). The latter method of recovery is thought to be the primary source of sediment supply for this region given the historically dynamic nature of Canaveral shoals.

Figures 4 and 5 present cross-sectional views of the borrow area at five discrete locations (see **Figure 2** for sections). The September 2000 data reference the pre- North Reach construction profile for CS-II and clearly illustrate the portion of CS-II that was affected by dredging for the North Reach project. As of January 2002, the borrow area had, on average, recovered 1 to 2 feet of the pre-dredge elevation. The principally affected area within CS-II experienced a maximum elevation increase of about 3 feet during this recovery period.

January 2002 (pre-South Reach) to April 15, 2002 (interim-South Reach)

Figures 6 and 7 picture bathymetric contours and changes in seafloor elevation based upon the January 2002 and April 15, 2002 surveys, respectively. The extent of the April 15, 2002 survey is limited to a small portion of CS-II and does not extend to the limits of the aforementioned, principally affected area. Dredging in CS-II, for construction of the South Reach, took place during this monitoring period, primarily after March 25, 2002. Contractor estimates place the total volume excavated from CS-II between 40,000 and 50,000 cy during this period. When compared to the natural background transport rate, the excavated dredge quantity is simply too small to yield a signal which may be reliably attributed to project construction. The data indicate that during this monitoring period, the surveyed area experienced a net gain of approximately 254,000 cy (+373,000 cy *gain* and –119,000 cy *loss*), despite the excavation of 40,000 to 50,000 cy by dredging. Theoretically, then the net gain without dredging would have been about +300,000 cy. Because this survey covers only a small portion of the borrow area over a short time, extrapolating this result to a longer perspective is not necessarily valid in a quantitative sense.

Qualitatively though, the cross-sectional representation shown in **Figures 4 and 5** suggests that the site utilized during North Reach construction continued to recover between January and April 2002, despite modest dredging activities. During this monitoring period, the surveyed portion of CS-II experienced elevation increases between 0 and 2.4 feet. Again, maximum gains were observed in the portions of CS-II that were most deeply excavated during North Reach construction.

Summary

During the approximate 9 month recovery period between north and South Reach construction, the confines of the CS-II borrow area experienced a total *gross* transport on the order of 1 Mcy. The computed *net* volumetric increase to the overall borrow area was approximately 332,250 cy, or about 445,000 cy/yr. The portion of CS-II excavated

during North Reach construction had a net recovery of about 193,700 cy, which equates to an annual *net gain* of about 260,000 cy/yr. The quantity of sand excavated between January and April 2002 (40,000-50,000 cy) comprises less than one-sixth of the background changes observed during the interim-monitoring period, and is therefore indistinguishable from natural changes within CS-II. Construction of the South Reach project is presently suspended for the duration of marine turtle nesting season, and dredging in CS-II is expected to resume after October 2002 and to be completed by April 30, 2003.

Please feel free to contact Kevin Bodge or myself should you have any questions or comments.

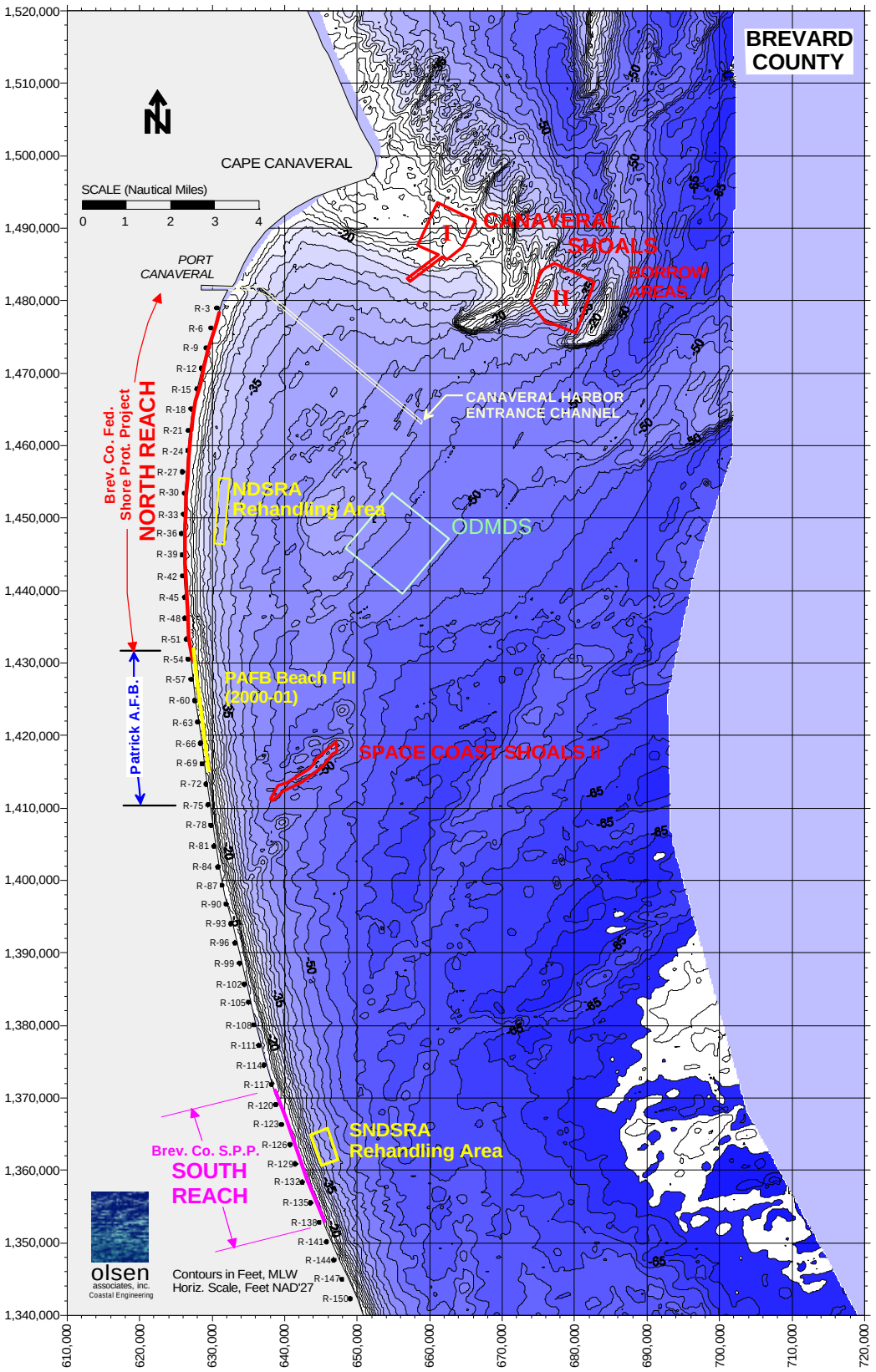


Figure 1 – General location map.

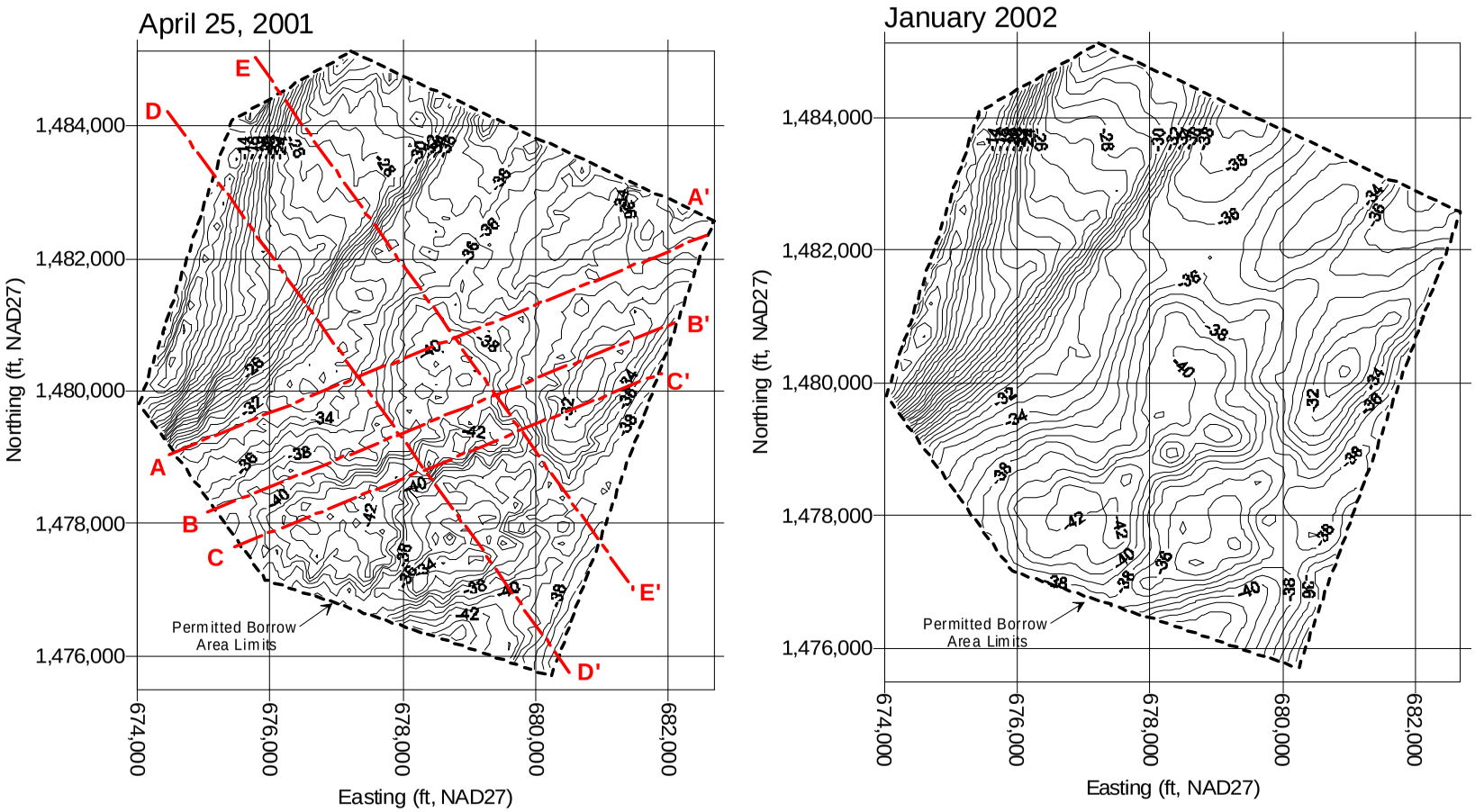


Figure 2 - Bathymetric surveys preformed on April 25, 2002 (post- north reach construction) and January 2002 (pre- south reach construction). Elevations are referenced in feet to Corp's MLW which is 1.9 feet below NGVD. Surveys were performed by Great Lakes Dredge and Dock Company.

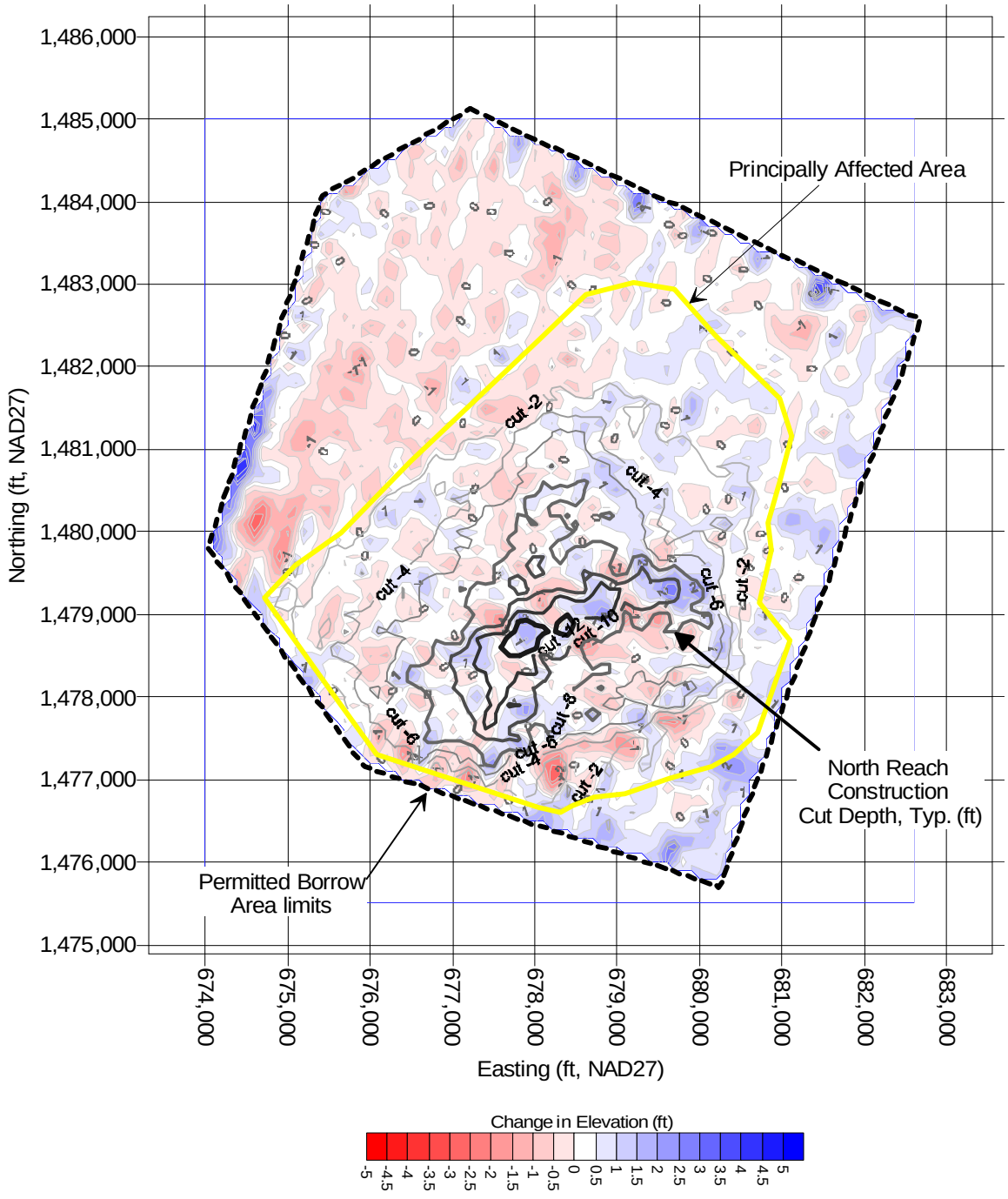


Figure 3 – Changes in elevation between April 25, 2001 and January 2002. Location and extent of North Reach construction cut is overlaid with black weighted contours.

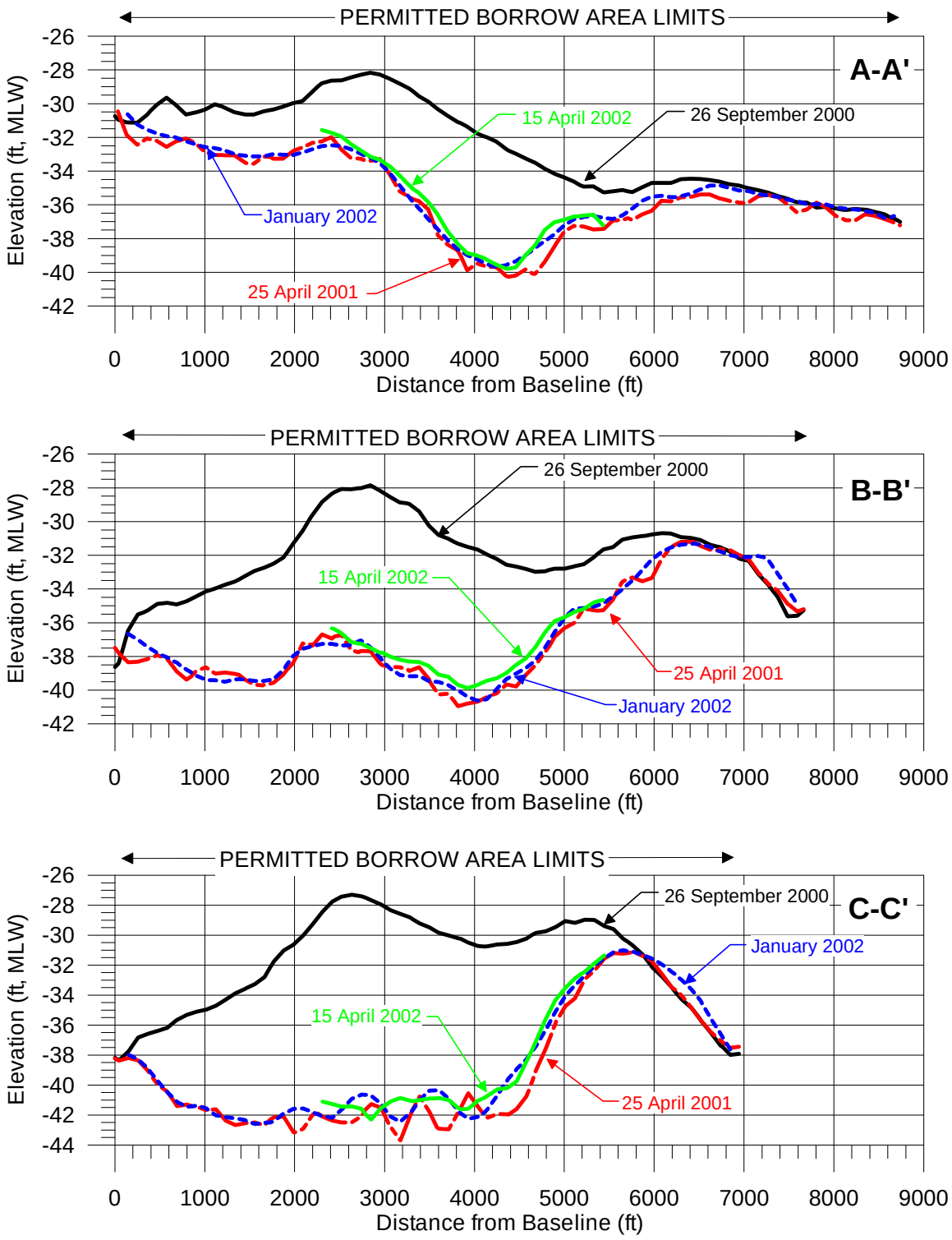


Figure 4 – Sectional cuts along profiles shown in **Figure 2**.

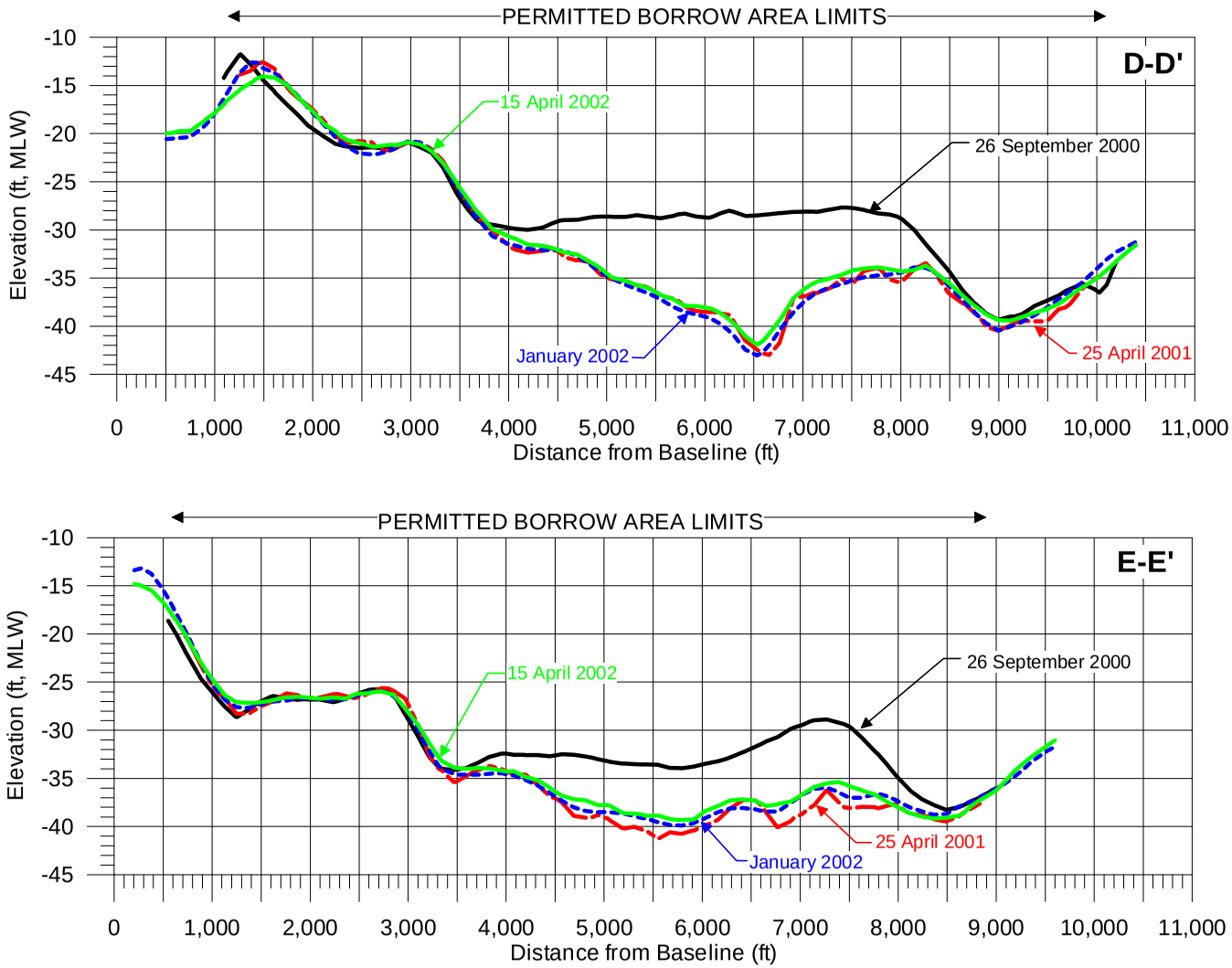


Figure 5 – Sectional cuts taken along profiles shown in **Figure 2** (continued).

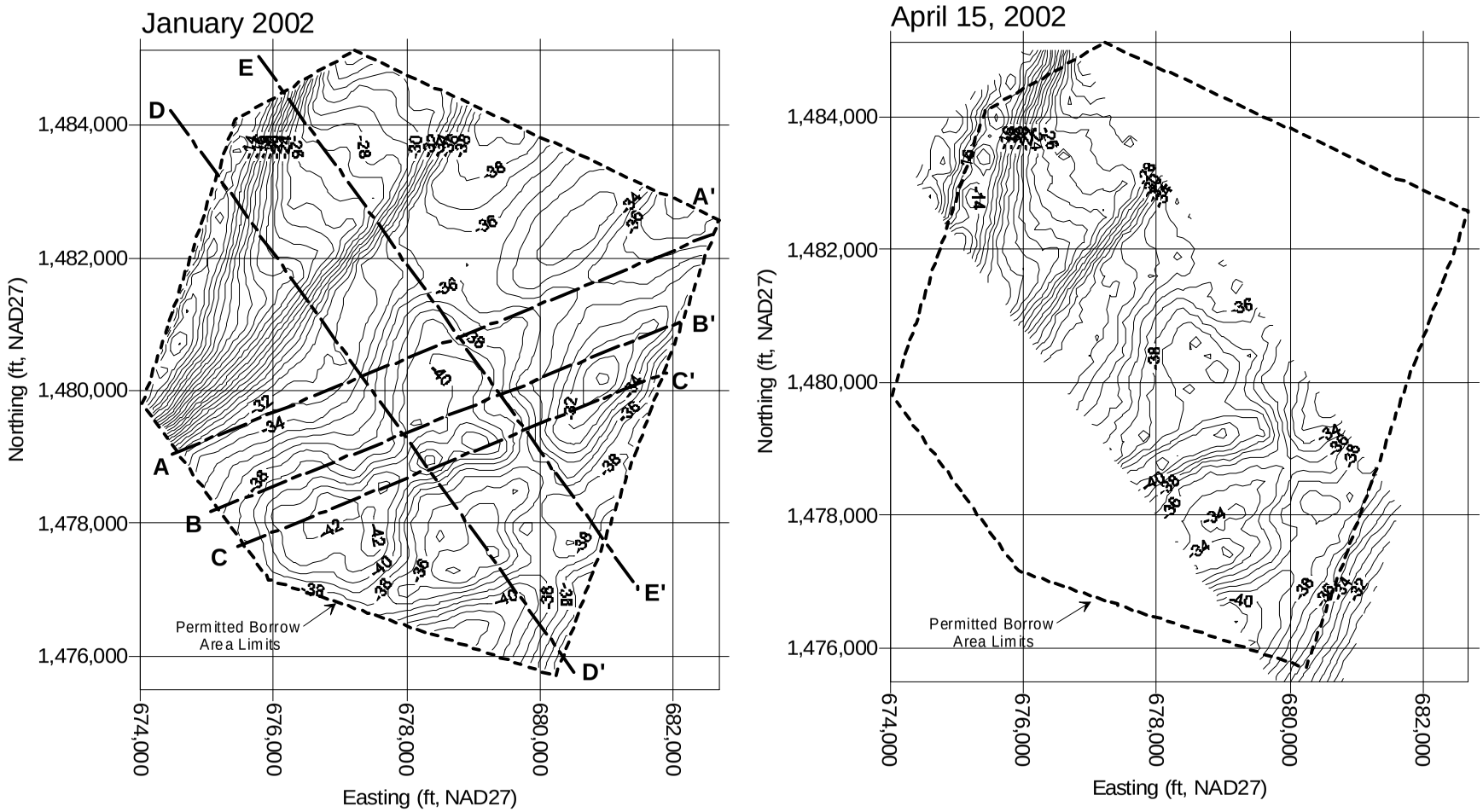


Figure 6 - Bathymetric surveys preformed on January 2002 (pre- south reach construction) and April 25, 2002 (interim- south reach construction). Elevations are referenced in feet to Corp's MLW which is 1.9 feet below NGVD. Surveys were performed by Great Lakes Dredge and Dock Company.

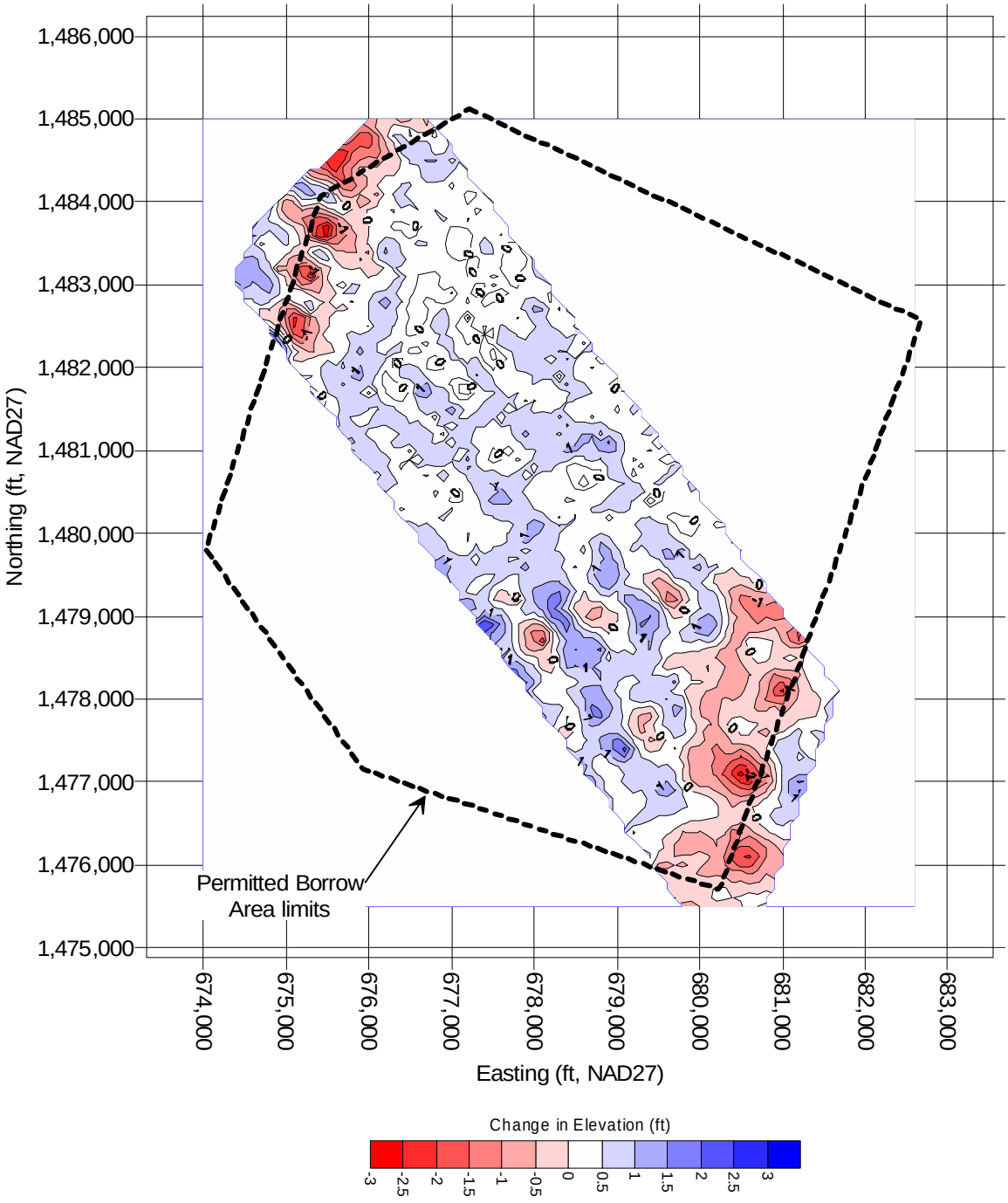


Figure 7 – Changes in seafloor elevation between January 2002 and April 15, 2002.

APPENDIX F:

South Reach Nearshore Disposal & Sand Rehandling Area Interim & Post-Construction Monitoring Reports

This appendix contains two reports pertaining to the construction monitoring of the SNDRA. The first report is titled "*Comparison of Pre- and Interim-Construction Surveys of the South Reach Nearshore Disposal and Sand Rehandling Area (SNDSRA) Brevard County Shore Protection, South Reach – Report No. 1*" and was prepared by Olsen Associates, Inc., March 14, 2002. The second report is titled "*Comparison of February 26, 2002 and April 23, 2002 Interim-Construction Surveys of the South Reach Nearshore Disposal and Sand Rehandling Area (SNDSRA) Brevard County Shore Protection Project, South Reach – Report No. 2*" and was prepared by Olsen Associates, Inc., May 31, 2002.

Report No. 1

Comparison of Pre- and Interim-Construction Surveys of the

South Reach Nearshore Disposal and Sand Rehandling Area (SNDSRA)

Brevard County Shore Protection, South Reach

14 March 2002

Comparison of Pre- and Interim-Construction Surveys

of the

South Reach Nearshore Disposal and Sand Rehandling Area
(SNDSRA)

Brevard County Shore Protection Project
South Reach

REPORT No. 1

Prepared By:
Olsen Associates, Inc.
4438 Herschel Street
Jacksonville, FL 32210
(904) 387-6114

14 March 2002

This letter report summarizes the volumetric changes of the South Reach Nearshore Disposal and Sand Rehandling Area (SNDSRA) of the Brevard County Shore Protection Project in Brevard County, Florida, in accordance with FDEP Bureau of Beaches and Wetlands Resources permit number 0137212-005JC. The changes are based on January 10, 2002 pre-construction and February 26, 2002 interim-construction (45-day) bathymetric surveys. Great Lakes Dredge & Dock Company, the contractor for the nourishment project, conducted these surveys. Figure 1 illustrates the location of the SNDSRA relative to the project shoreline and borrow areas.

Figure 2 plots the bathymetric contours in the vicinity of the permitted rehandling area for the pre-construction and interim-construction surveys. Dredging of the Space Coast Shoals II borrow area commenced on January 14, 2002, and a single area within the permitted SNDSRA has been used for nearshore disposal. Figure 3 presents the changes in seabed elevation resulting from the disposal operations. Comparison of the

survey data indicates that the effected disposal area contains approximately 788,900 cy of placed material. All of the material was dredged from the Space Coast Shoals II borrow site except for 3,500 cy cut from Canaveral Shoals II on January 23, 2002. As of the February 26 survey date, the contractor estimated the nearshore placement volume at approximately 771,786 cy, about 2 percent less volume than the computed estimate but within acceptable limits for error. No rehandling (dredging and beach nourishment) activity occurred during the survey period. Beach fill placement from the SNDSRA commenced on March 14, 2002.

Figure 4 presents profile section views of the disposal areas for both surveys (sections shown in Figure 2). Section D-D' runs through the largest portion of the effected disposal area and indicates the disposal pile is on average 19.5 ft in relief and 1,700 ft in cross-shore width. Sections B-B' and C-C' have approximately 17.5 ft of relief (on average) and cross-shore dimensions similar to section D-D'. The maximum relief in the disposal area is 21.5 feet above the ambient sea floor. The disposal pile has a maximum crest elevation of –21.5 ft above MLW. The permitted limit for disposal within the SNDSRA is –21 ft, MLW. The surveys indicate that the seaward toe of the stockpiled material falls up to about 200 ft outside the permitted limits of disposal, but the placement of the sand is otherwise consistent with the specifications.

The next interim survey of the SNDSRA will be conducted in mid- to late-April. This may coincide with the end of dredging activity for this winter season, stipulated as April 30.

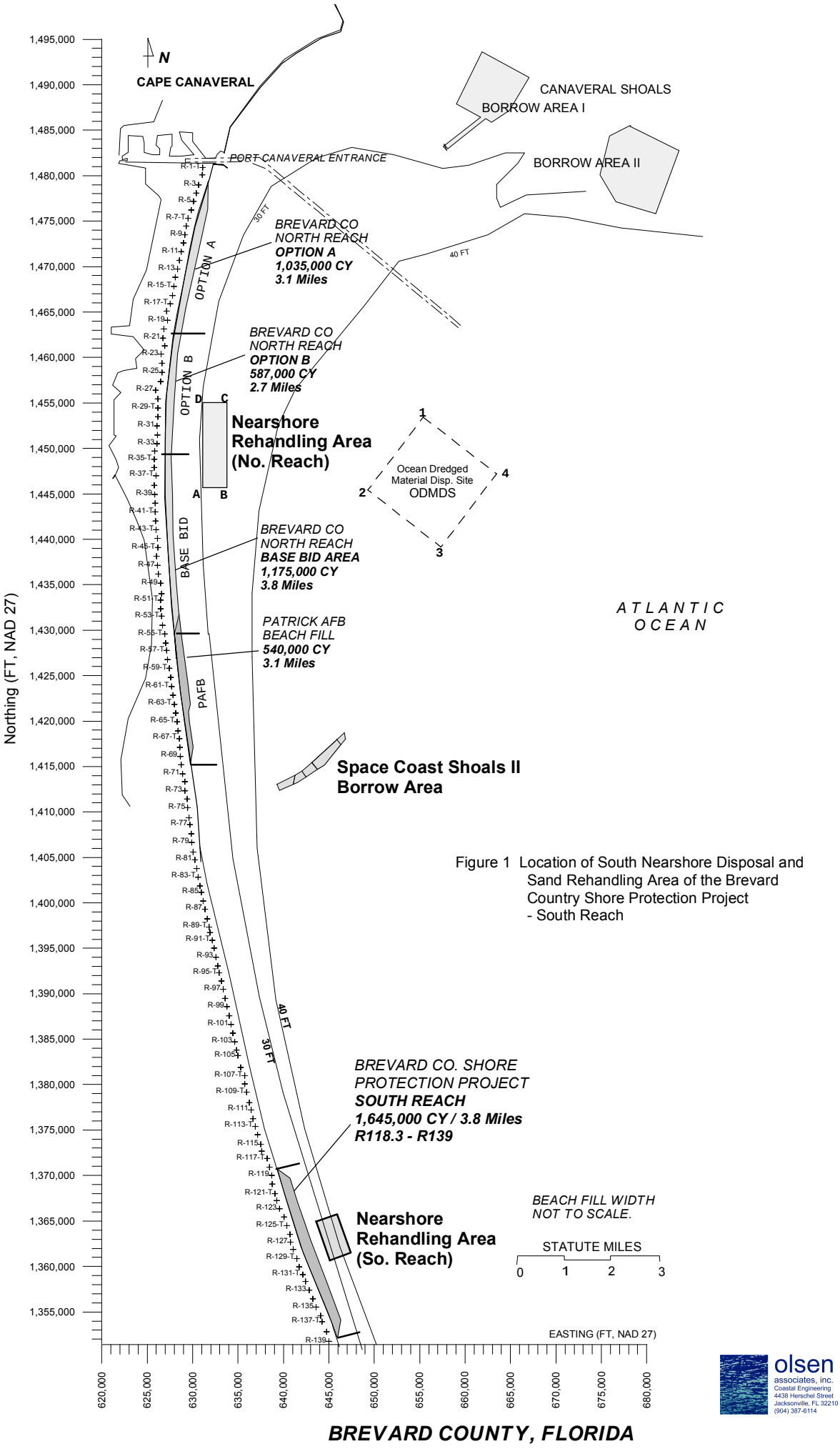


Figure 1 Location of South Nearshore Disposal and Sand Rehandling Area of the Brevard Country Shore Protection Project - South Reach

olsen
associates, inc.
Coastal Engineering
4438 Herschel Street
Jacksonville, FL 32210
(904) 387-6114

BREVARD COUNTY, FLORIDA

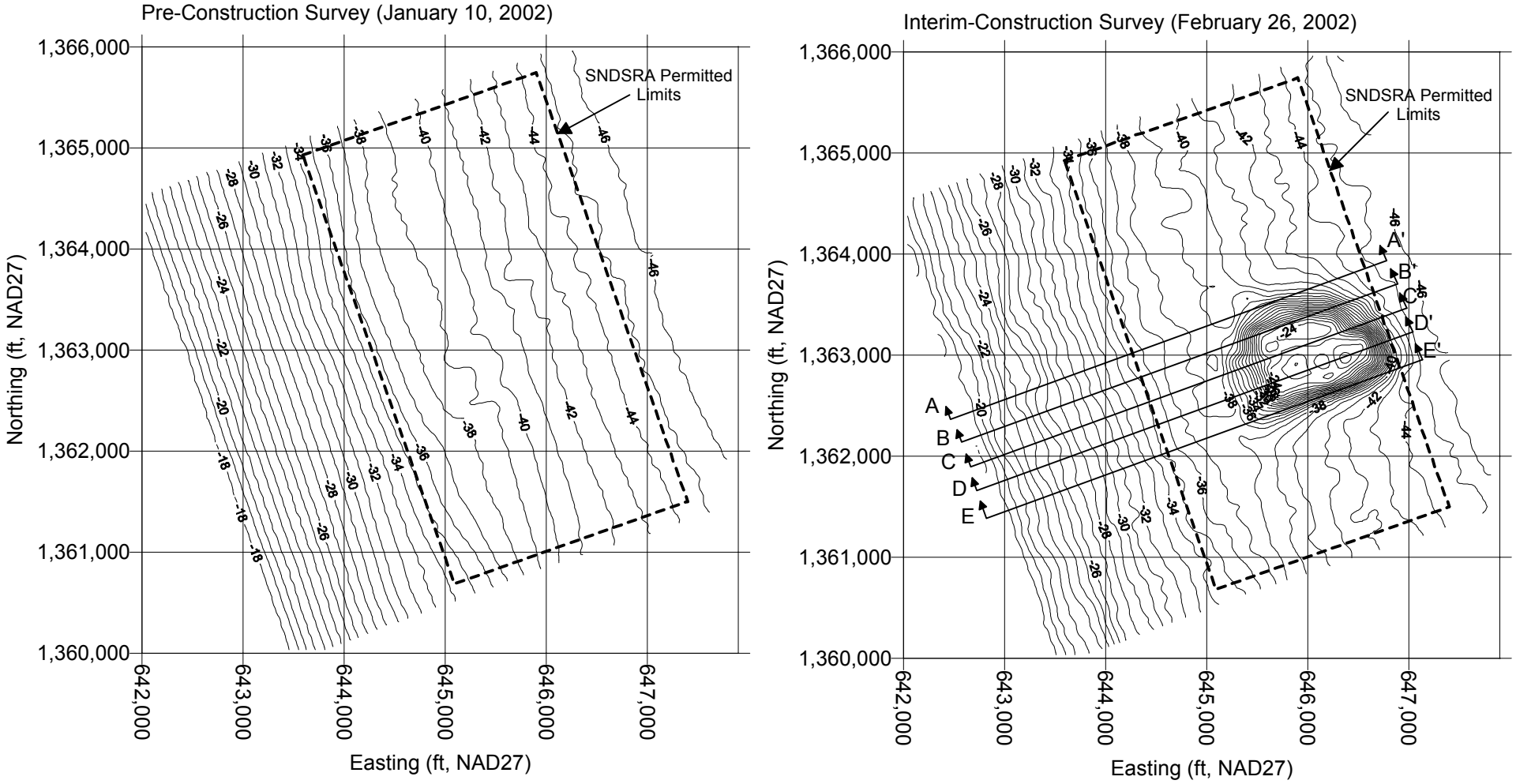


Figure 2 South Nearshore Disposal and Sand Rehandling Area (SNDSRA) - Brevard County Shore Protection Project - South Reach. 10 January 2002 and 26 February 2002 Pre- and interim-construction surveys respectively. Contours represent elevation relative to Mean Low Water Datum (-1.9-ft NGVD). Surveys by Great Lakes Dredge and Dock, Inc.

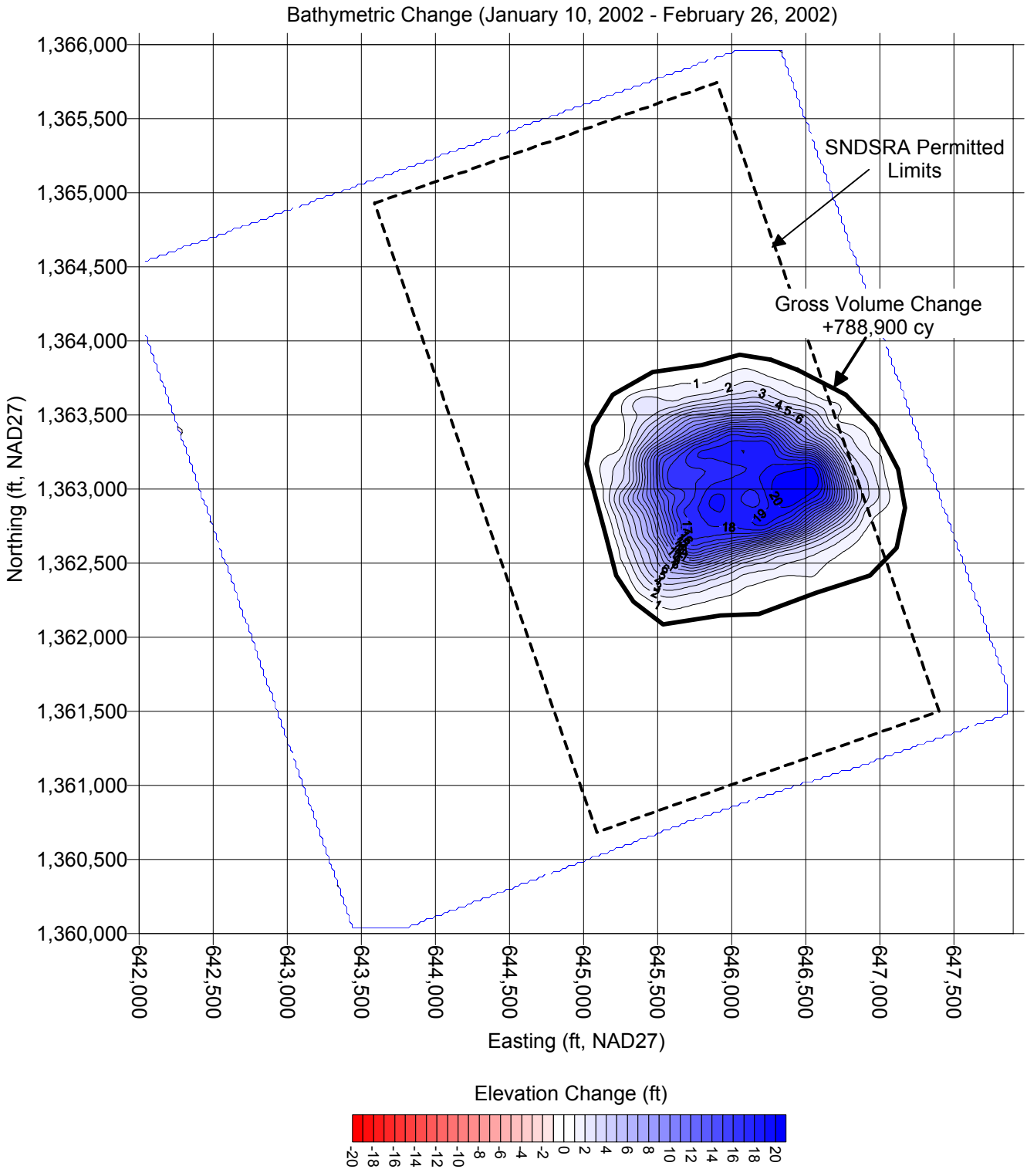


Figure 3 Contours of seabed elevation change for the South Nearshore Disposal and Sand Rehandling Area (SNDSRA) of the Brevard County Shore Protection Project - South Reach - between the 10 January 2002 pre-construction and 26 February 2002 interim surveys.

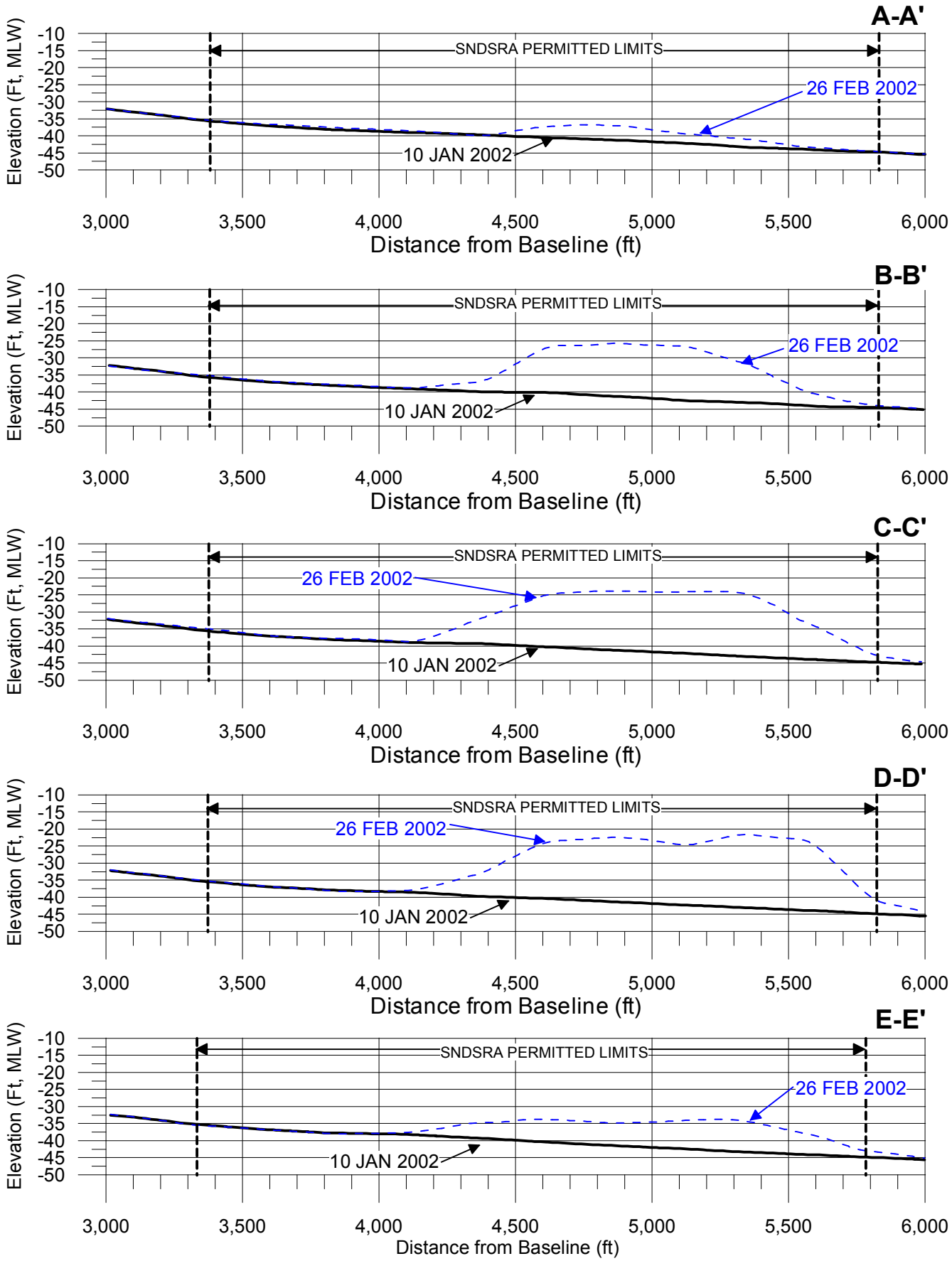


Figure 4 Profile section views of the south Nearshore Disposal and Sand Rehandling Area of the Brevard County Shore Protection Project - South Reach. See Figure 2 for section locations.

Report No. 2

Comparison of February 26, 2002 and April 23, 2002 Interim-Construction Surveys

of the South Reach Nearshore Disposal and Sand Rehandling Area (SNDSRA)

Brevard County Shore Protection Project, South Reach

Report No. 2

31 May 2002

Comparison of February 26, 2002 and April 23, 2002 Interim-Construction Surveys

of the

South Reach Nearshore Disposal and Sand Rehandling Area
(SNDSRA)

Brevard County Shore Protection Project
South Reach

REPORT No. 2

Prepared By:
Olsen Associates, Inc.
4438 Herschel Street
Jacksonville, FL 32210
(904) 387-6114

May 31, 2002

This letter report summarizes the volumetric changes in the South Reach Nearshore Disposal and Sand Rehandling Area (SNDSRA) of the Brevard County Shore Protection Project in Brevard County, Florida, in accordance with FDEP Bureau of Beaches and Wetlands Resources permit number 0137212-005JC. The changes are based on the January 10, 2002, February 26, 2002, and April 23, 2002 bathymetric surveys (pre-construction, 45-day and 90-day, respectively). Great Lakes Dredge & Dock Company, the contractor for the nourishment project, conducted these surveys. **Figure 1** illustrates the location of the SNDSRA relative to the project shoreline and borrow areas.

Figure 2 plots the bathymetric contours in the vicinity of the permitted rehandling area as recorded by the February 26, 2002 and April 23, 2002 interim-construction surveys. Dredging of the Space Coast Shoals II (SCS II) borrow area commenced on January 14, 2002. Excavated material was subsequently transported to the SNDSRA, whereby it was rehandled by cutter-head dredge and placed onto the south reach beaches between March 12, 2002 and April 24, 2002.

Project construction was suspended on April 24, 2002 in consideration of permit conditions regarding marine turtle nesting season.

Cutter-head rehandling within the SNDSRA coincided with disposal activities; thus, available SNDSRA monitoring data cannot provide an accurate measurement of either handling losses incurred between the borrow and rehandling areas or the total volume placed within the SNDSRA. Analysis of pre- and post-construction borrow area survey data suggests that about 1.45 Mcy of sand were dredged for placement into the nearshore rehandling area. Of this volume, approximately 1.41 Mcy were dredged from the SCS II borrow area, and the contractor estimates that roughly 0.04 Mcy were excavated from the Canaveral Shoals II borrow area.

Figure 3 presents the changes in seabed elevation observed in the vicinity of the SNDSRA between the February 26, 2002 and April 23, 2002 interim-construction surveys. Data indicate that during this monitoring period, the principal "work area" within the SDNSRA experienced a net volume change of approximately -540,900 cy (loss). During the same period, there was a net volume change of about -622,140 cy (loss) within the entire SNDSRA. The maximum elevation change within the rehandling area during this period was approximately 20 feet. The reported volume change outside of the principal work area is attributed to differences in survey methods. The January 2002 (pre-construction) and February 2002 (45-day) survey tracks are both oriented parallel to the local seabed contours (north-south). This results in a reduced ability to resolve subtle changes in relief along portions of the SNDSRA where bathymetric contours are relatively straight and parallel. The April 2002 (90-day) survey tracks are oriented perpendicular to the seabed contours (east-west), which can more faithfully resolve

bathymetric subtleties. Comparing surveys with contour-parallel and contour-perpendicular track lines generates a false numeric impression of volumetric change along flat (or uniformly sloping) sections of the seabed where no construction took place.

Figure 4 presents the changes in seabed elevation between January 10, 2002 and April 23, 2002 (pre-construction to 90-day). The primary area of construction within the rehandling area experienced a net volume gain of approximately +252,800 cy, while the entire SNDSRA experienced a net volume gain of about +194,800 cy. Again, the apparent volume decrease outside the work area is attributed to the aforementioned survey track differences. Despite survey irregularities, the computed volume of material remaining within the SNDSRA agrees well with contractor estimates of 200,000 to 250,000 cy. The survey data suggest that a small section of the ambient seabed was encroached upon by the cutter-head, equating to approximately 1.2 percent of the principal work area or about 0.5 percent of the total permitted rehandling area limits. The maximum cut depth in this area penetrated less than 1 foot below pre-construction grade. It is believed that this occurred during a period of high seas in mid-April.

Figure 5 presents several cross-sectional views through the effected portion of the rehandling area. The data indicate that, as of February 2002, material was stockpiled to a maximum elevation of about 19.5 feet above the local pre-construction seabed. Currently, the maximum sand stockpiles extend to approximately 5.6 feet above ambient grade. Between 0 and 2 feet of material remain in an area approximately 1,200 feet long and extending about 350 feet outside of the easternmost SNDSRA limits (see **Figure 4**). This material reposed outside of the

permitted limits following the stockpiling of large volumes near the easternmost permitted boundary along sections B-B', C-C', and D-D'.

In summary, approximately 1.45 Mcy of sand were dredged from offshore borrow areas, for placement within the SNDSRA. Of this volume, between 1.2 and 1.24 Mcy of fill were reportedly placed on to the south reach project between March 12, and April 24, 2002. Currently, between 200,000 and 252,000 cy of placed sand remains in the nearshore rehandling area. Construction is scheduled to recommence after October 2002 and be completed by April 30, 2003.

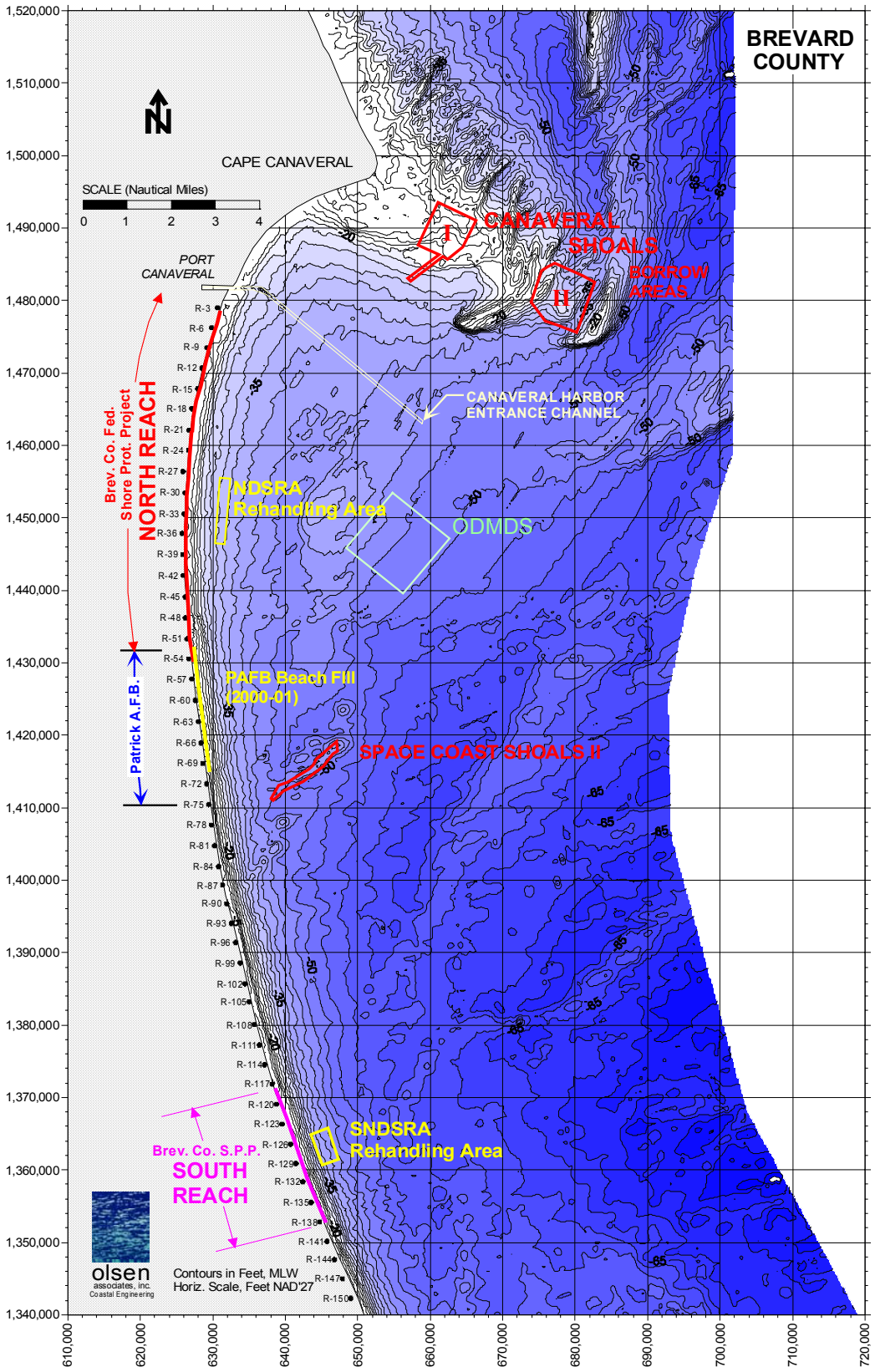


Figure 1 – General location map.

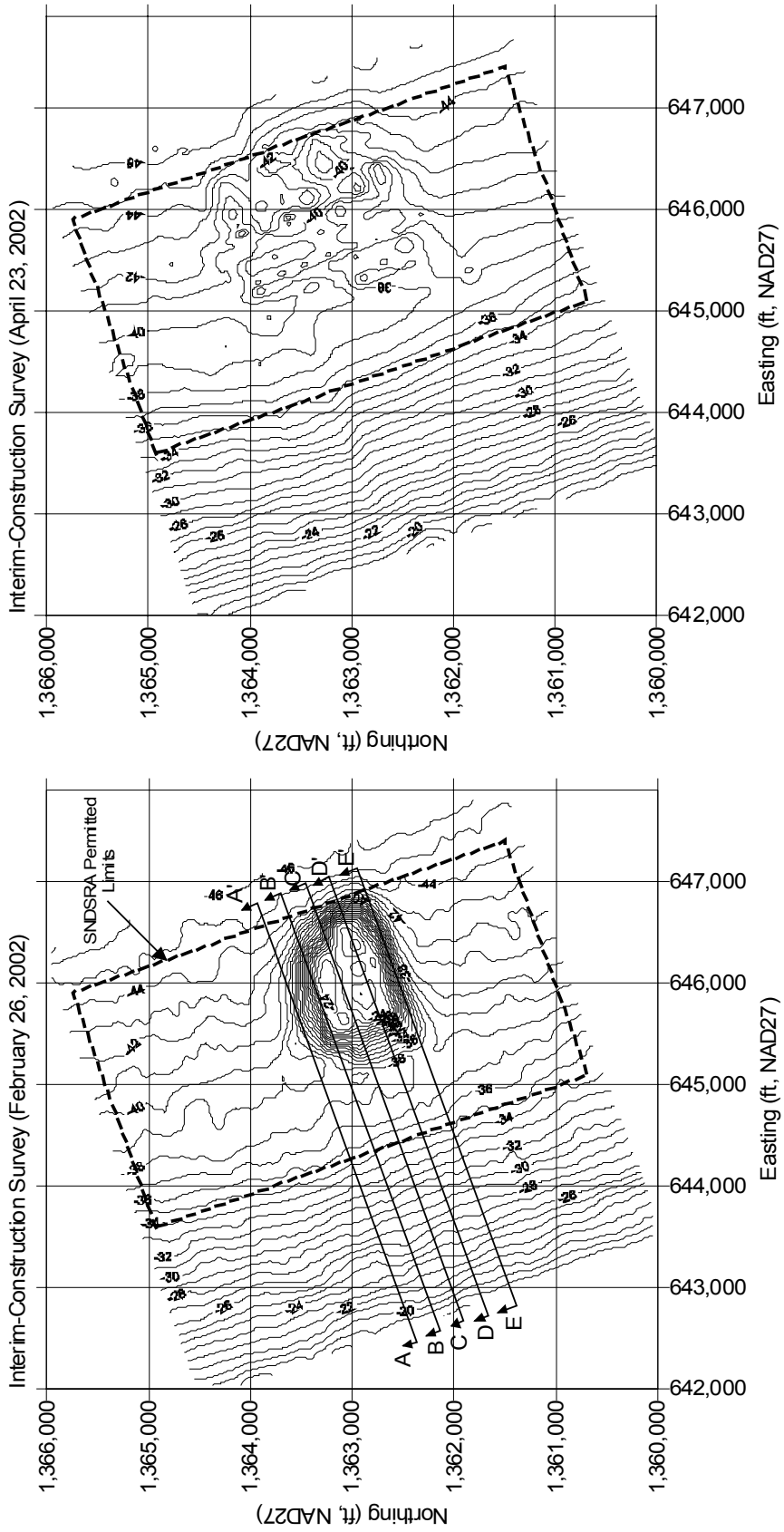


Figure 2 South Nearshore Disposal and Sand Rehandling Area (SNDSRA) - Brevard County Shore Protection Project - South Reach. 26 February 2002 and 23 April 2002 interim-construction surveys. Contours represent elevation relative to Mean Low Water Datum (-1.9-ft NGVD). Surveys by Great Lakes Dredge and Dock Company.

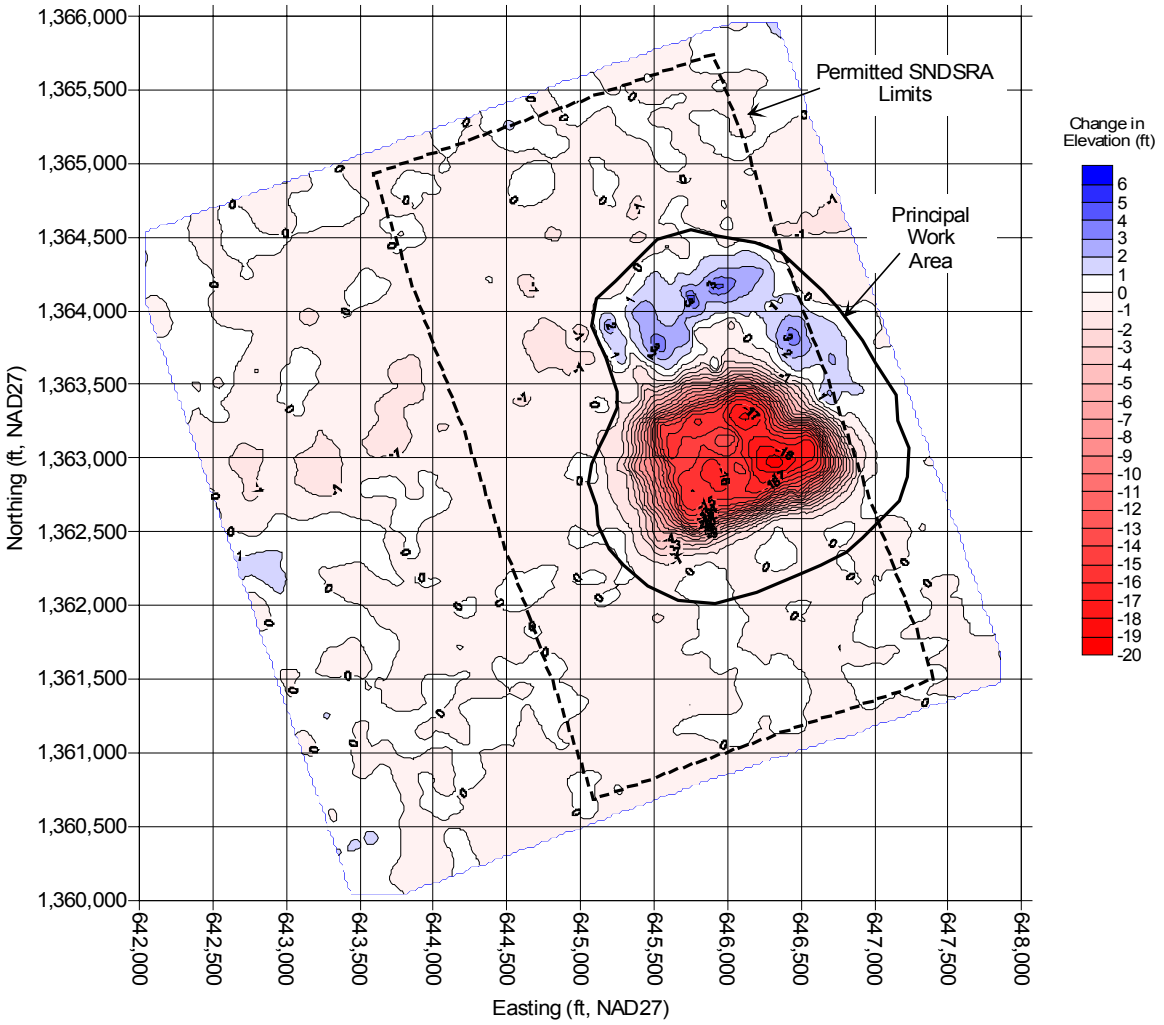


Figure 3 – Change in seafloor elevation between February 26, 2002 and April 23, 2002.

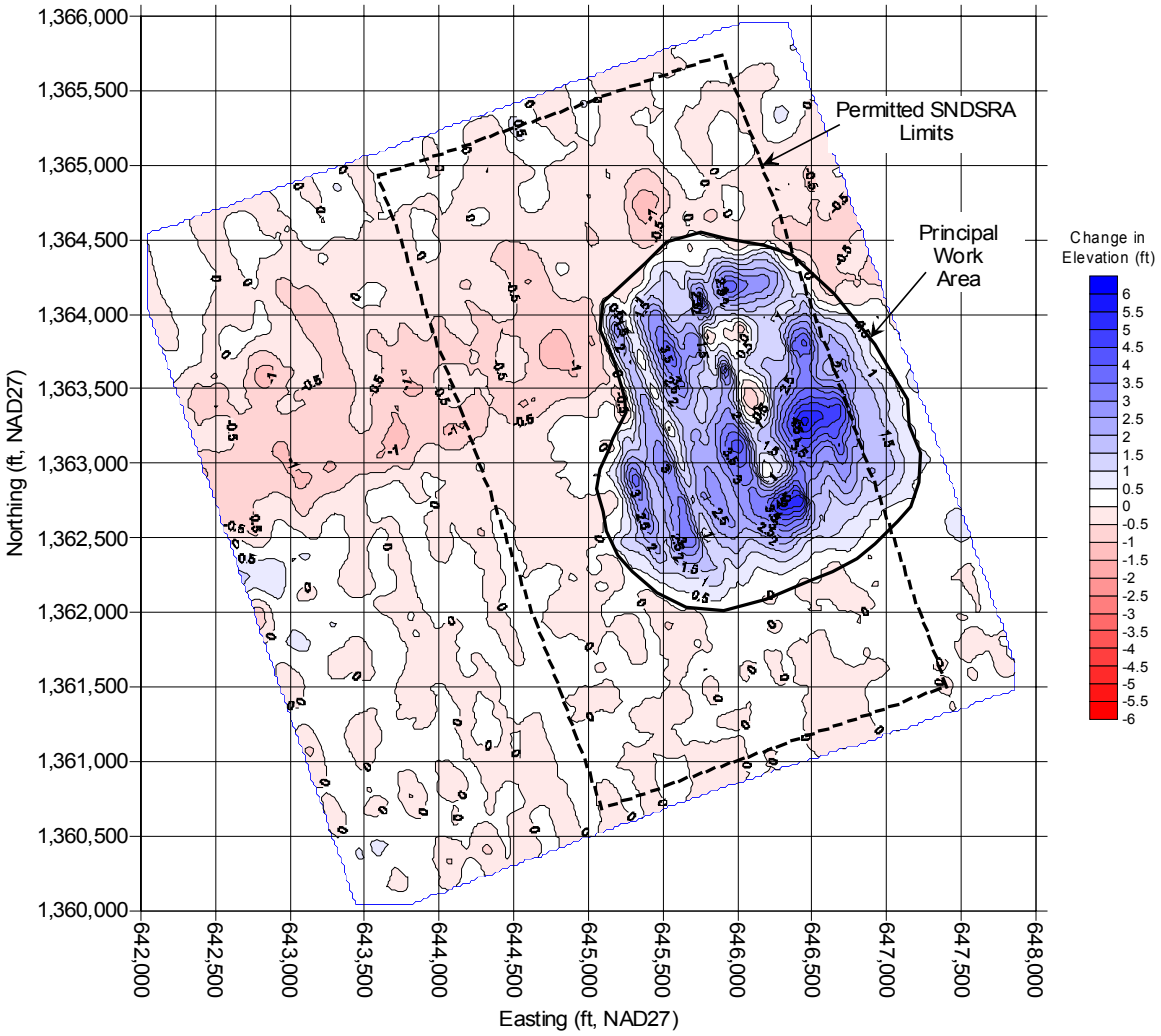


Figure 4 – Change in seafloor elevation between January 10, 2002 and April 23, 2002.

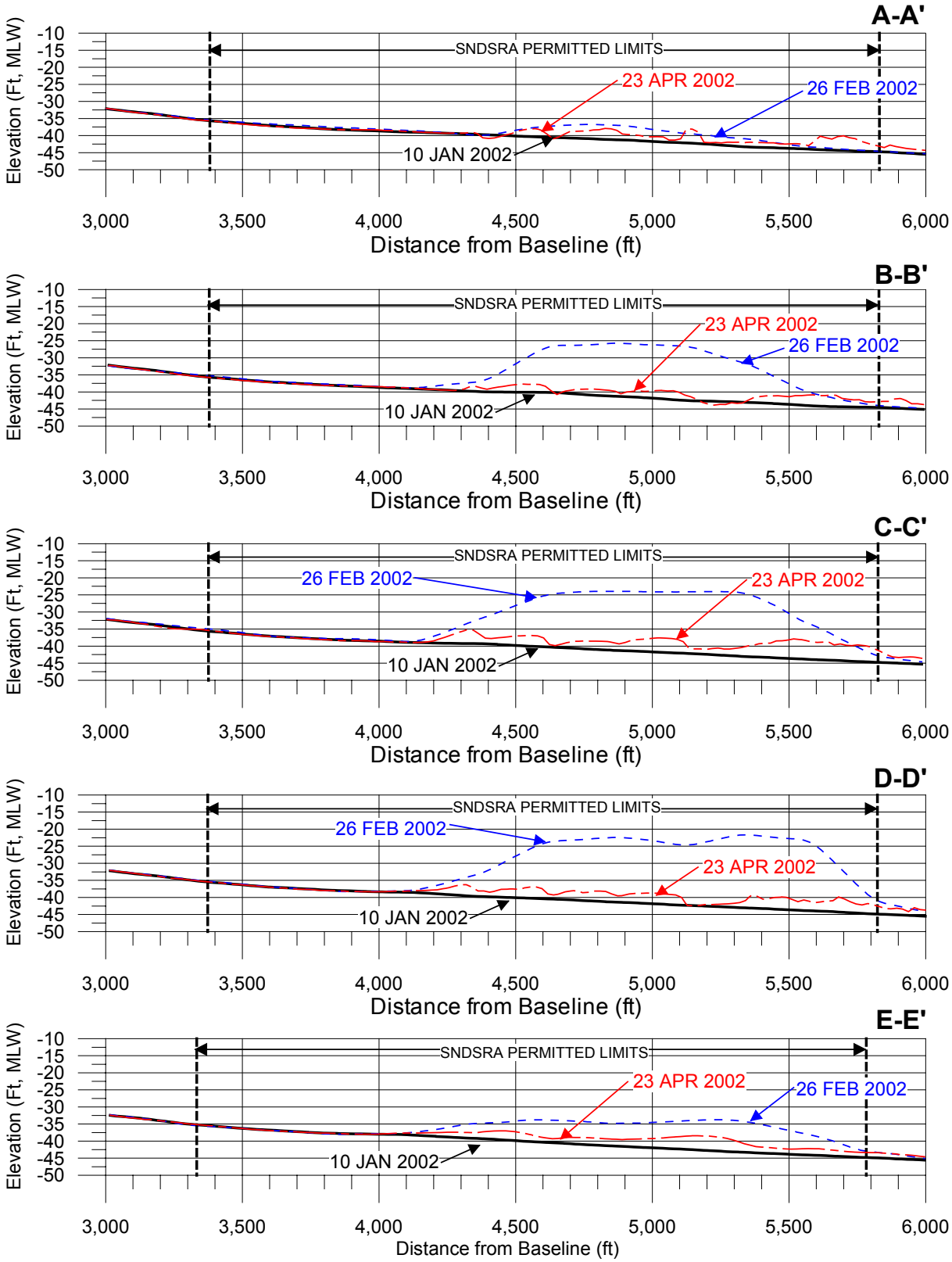


Figure 5 - Profile section views of the south Nearshore Disposal and Sand Rehandling Area of the Brevard County Shore Protection Project - South Reach. See Figure 2 for section locations.

APPENDIX G:

South Reach Post-Construction Geotechnical Monitoring Report

This appendix contains the report titled "*Post-Construction Geotechnical Monitoring of the South Reach Beach Nourishment Sediment; Brevard County Federal Shore Protection Project*", prepared by Olsen Associates, Inc., July 28, 2003.

Post-construction Geotechnical Monitoring
of the
South Reach Beach Nourishment Sediment

Brevard County Federal Shore Protection Project

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July 28, 2003

This report describes the geotechnical characteristics of sediments utilized in the initial construction of the South Reach segment of the Brevard County Shore Protection Project. The South Reach was constructed in two intervals: between January 2002 and April 2002, and between March 2003 and May 2003. These monitoring efforts constitute the post-construction monitoring which is requisite under the FDEP Bureau of Beaches and Wetlands Resources permit number 0137212-008JC. The first phase construction of the South Reach in 2002 resulted in the total depletion of the Space Coast Shoals II offshore borrow area (SCS-II). The second-phase of construction in 2003 borrowed sand solely from the Canaveral Shoals II offshore borrow area (CS-II). **Figure 1** depicts the general location of applicable project components.

Between January 14, 2002 and about March 31, 2002 approximately 1.41 Mcy of beach compatible sediment were removed from the SCS-II borrow area and placed into the South Reach Nearshore Disposal and Sand Rehandling Area (SNDSRA). In addition to this, a small volume of sand (40,000 – 50,000 cy) was also dredged from CS-II and placed into the SNDSRA. Between 1.40 and 1.42 Mcy of the dredged sand was subsequently rehandled by cutter-head dredge and utilized in construction of the southern 15,500 feet of the South Reach beach fill. The remaining northern 4,500 feet of the South Reach was constructed from March 28, 2003 to April 26, 2003 using between

325,000 and 384,000 cy of sand dredged from the Canaveral Shoals II borrow area (CS-II) and placed by direct hopper dredge pump-out.

A total of 42 physical samples of the placed fill material were collected from the construction berm and analyzed for grain size distribution. The results are summarized in **Table 1**. Additionally, 6 samples were analyzed for carbonate composition by high-temperature burn, for which the results are listed in **Table 2**.

The sand samples were collected in May 2002 and May 2003 along the landward- and mid-berm locations of each of the 21 alongshore sites, at depth of approximately 12 inches below the surface of the fill. The landward berm samples were typically collected 5 to 20 feet seaward of the project's dune feature in order to exclude native beach material. Of the 21 alongshore sample locations, 17 were from the beach fill completed in April 2002 and represent material primarily from SCS-II, which was rehandled by cutter-head dredge. The other 4 alongshore sample locations were in the beach fill completed in April 2003 and represent material from CS-II placed by direct pump-out. All of the samples were collected along the sampling area within less than about 30 to 45 days after the beach fill was constructed.

Ellis & Associates, Inc. (Jacksonville, FL) performed the grain size sieve analyses and visual estimates of shell content, and SEA Inc. (Melbourne, FL) performed the high-temperature carbonate burn tests. For reference purposes, **Table 3** presents grain size distributions for the borrow area composites and the average native sediments.

Table 1 – Sieve analysis of the South Reach construction berm.

GRADATION TEST

	Percent Passing										
CS-II 2003 Sample ID	No 4	No 10	No 30	No 40	No 50	No 60	No 70	No 100	No 140	No 200	Estimated Shell Content (%)
Sieve Size (mm)	4.75	2.0	0.6	0.425	0.30	0.25	0.212	0.15	0.106	0.075	
R118.4 Mid-Berm	96.0	91.4	75.1	58.6	30.1	12.9	4.6	1.2	0.7	0.6	25-33
R118.4 Landward Berm	97.9	94.7	80.8	65.5	36.5	18.4	7.6	2.2	1.1	0.7	20-28
R118.9 Mid-Berm	98.8	96.6	85.9	71.4	38.8	19.2	7.2	2.1	1.2	0.9	14-20
R118.9 Landward Berm	99.6	99.1	89.1	71.3	35.5	14.8	4.2	0.6	0.2	0.1	11-20
R120 Mid-Berm	99.9	99.1	94.6	82.6	38.6	14.1	4.2	0.9	0.5	0.3	5-11
R120 Landward Berm	99.8	99.4	93.3	81.3	47.6	21.6	6.7	1.3	0.6	0.4	2-10
R121 Mid-Berm	97.5	93.9	80.6	66.9	37.5	17.1	5.6	1.5	0.8	0.6	20-27
R121 Landward Berm	97.7	95.6	85.0	71.0	39.1	20.5	7.1	2.0	1.3	1.2	15-22
All CS-II Samples -- Average	98.4	96.2	85.6	71.1	38.0	17.3	5.9	1.5	0.8	0.6	
CS-II Landward Berm -- Average	98.8	97.2	87.1	72.3	39.7	18.8	6.4	1.5	0.8	0.6	
CS-II Mid-berm -- Average	98.1	95.3	84.1	69.9	36.3	15.8	5.4	1.4	0.8	0.6	

	Percent Passing									
SCS-II 2002 Sample ID	No. 4	No. 10	No. 20	No. 30	No. 40	No. 50	No. 70	No. 100	No. 200	Estimated Shell Content (%)
Sieve Size (mm)	4.75	2.0	0.85	0.6	0.425	0.3	0.212	0.15	0.075	
R122.1 Landward Berm	100.0	99.6	90.2	84.1	66.0	34.0	6.4	1.3	0.6	8-10
R122.1 Mid Berm	99.6	97.0	79.5	71.4	58.4	36.3	9.4	2.1	0.6	28-35
R123.3 Landward Berm	99.3	97.1	85.0	75.7	61.2	43.5	13.4	2.4	0.8	15-20
R123.2 Mid Berm	96.4	92.3	81.8	76.7	65.9	40.5	11.7	3.2	1.6	18-20
R124.2 Landward Berm	98.5	96.1	89.1	83.7	68.9	41.6	10.8	2.0	0.7	10-14
R124.2 Mid Berm	99.3	96.8	86.4	81.4	70.3	45.2	11.1	1.5	0.3	18-24
R124.5 Landward Berm	99.7	99.2	96.9	93.7	78.3	40.2	7.2	1.2	0.1	3-5
R124.5 Mid Berm	95.5	90.6	78.7	73.6	63.3	38.5	11.0	1.5	0.4	20-24
R125.4 Landward Berm	99.8	99.4	96.5	92.0	72.1	37.8	8.1	1.6	0.4	3-5
R125.4 Mid Berm	95.2	88.1	74.4	63.2	25.2	8.9	1.5	0.4	0.0	25-30
R126A Landward Berm	99.5	98.7	94.2	90.3	76.7	46.5	12.4	2.0	0.4	6-8
R126A Mid Berm	97.6	94.7	86.8	82.6	72.8	49.1	14.4	3.2	1.3	13-15
R127A Landward Berm	97.3	93.4	83.8	79.5	70.8	46.6	12.0	2.3	0.4	6-10
R127A Mid Berm	93.5	87.0	73.8	68.4	57.8	35.4	9.5	1.7	0.6	25-28
R128.7 Landward Berm	98.9	98.2	94.4	90.5	78.8	46.6	10.5	1.4	0.2	6-8
R128.7 Mid Berm	97.9	95.2	87.0	82.6	71.2	45.9	11.8	1.8	0.5	16-22
R130 Landward Berm	96.6	89.9	71.2	64.1	53.0	29.7	6.9	1.5	0.4	36-42
R130 Mid Berm	99.5	97.6	90.9	85.8	70.6	38.4	7.4	1.2	0.3	14-22
R131 Landward Berm	99.1	96.4	86.7	80.6	67.0	38.1	7.5	0.6	0.0	20-28
R131 Mid Berm	92.7	84.7	69.5	63.1	53.1	34.5	11.6	4.3	2.3	37-42
R132.3 Landward Berm	94.9	87.8	74.5	68.8	57.4	33.7	8.9	1.8	0.7	25-28
R132.3 Mid Berm	99.1	95.2	81.9	74.4	57.6	26.3	6.0	1.2	0.5	18-22
R133.5 Landward Berm	96.7	91.1	79.8	74.6	63.4	38.5	10.5	2.1	0.7	25-30
R133.5 Mid Berm	98.4	90.4	69.1	59.7	45.7	21.1	2.7	0.1	0.0	30-35
R134.5 Landward Berm	97.6	93.2	82.7	77.7	66.9	40.5	10.8	1.5	0.3	17-20
R134.5 Mid Berm	93.1	85.9	72.8	67.5	56.2	33.7	8.4	1.2	0.4	27-30
R135.7 Landward Berm	95.5	88.4	75.2	69.6	58.8	34.8	10.2	2.2	0.8	25-28
R135.7 Mid Berm	96.6	91.5	80.6	75.6	63.9	37.3	10.4	2.5	1.1	20-23
R136.8 Landward Berm	99.7	98.8	93.9	88.9	71.6	36.8	7.4	2.0	0.8	6-10
R136.8 Mid Berm	92.8	84.7	70.3	64.9	53.8	33.6	8.1	1.6	0.5	30-33
R137.7 Landward Berm	99.8	96.4	79.1	68.4	46.0	22.2	3.7	0.8	0.4	21-26
R137.7 Mid Berm	98.1	94.9	87.8	83.6	70.0	33.6	5.8	1.2	0.4	12-14
R138.5 Landward Berm	97.7	92.8	82.8	78.2	68.3	47.6	12.0	1.7	0.3	17-20
R138.5 Mid Berm	93.0	83.5	66.3	60.2	47.1	24.2	5.5	1.1	0.4	34-36
All SCS-II Samples -- Average	97.3	93.1	82.2	76.3	62.6	36.5	9.0	1.7	0.6	
SCS-II Landward Berm -- Average	98.3	95.1	85.6	80.0	66.2	38.7	9.3	1.7	0.5	
SCS-II Mid Berm -- Average	96.4	91.2	78.7	72.6	59.0	34.3	8.6	1.8	0.7	

Table 2 – Calcium Carbonate content of the Native Beach, South Reach Fill, SCS-II, and CS-II.

South Reach Project

SAMPLE ID	Percent $CaCO_3$
R-122.1 Mid Berm South Reach	43.2
R-124.2 Landward Berm South Reach	28.4
R-126A Landward Berm South Reach	22.8
R-128.7 Mid Berm South Reach	29.0
R-131 Landward Berm South Reach	31.2
R-133.5 Mid Berm South Reach	51.5
Average of South Reach Samples	34.3
Average SCS-II	38.0
Average CS-II	39.0
Average CS-II (*in place*)	41.1

Native Beach

SAMPLE ID	Percent $CaCO_3$
Native Berm 1	53.6
Native Berm 2	40.3
Native Berm 3	16.2
Native Intertidal 1	44.4
Native Intertidal 2	40.8
Average - Native Berm	36.7
Average - Overall	39.0

Table 3 – Grain size distributions for representative native and borrow samples (percent passing).

Sieve Designation	0.625"	No. 4	No. 10	No. 20	No. 30	No. 40	No. 50	No. 60	No. 70	No. 80	No. 140	No. 200
CS-II	100.0	98.8	96.6	89.2	80.5	64.3	36.6	20.4	11.7	5.2	1.5	1.2

Sieve Designation	0.625"	0.438"	0.3125"	No. 3.5	No. 5	No. 7	No. 10	No. 14	No. 18	No. 25	No. 35	no. 45
SCS-II	99.8	99.3	98.4	97.1	95.8	94.1	92.2	89.2	85.5	80.7	75.7	62.9

No. 60	No. 80	No. 120	No. 170	No. 200
38.7	9.7	1.8	1.2	1.1

Sieve Designation	No. 10	No. 20	No. 30	No. 40	No. 60	No. 80	No. 120	No. 200
Native - Berm Average	98.8	94.4	86.2	61.9	13.1	4.1	2.4	0.7
Native - MSL & SEAWARD	99.8	97.6	94.3	86.2	53.9	26.7	10.5	1.2
Native - Overall	99.3	96.0	90.2	74.0	33.5	15.4	6.5	0.9

The South Reach Fill averages approximately 34.3 percent calcium carbonate, with the carbonate measured in individual samples ranging from 22.8 to 51.5 percent. This compares well with the native berm and intertidal beach, which contains an average 36.7 percent calcium carbonate with pre-project native samples ranging between 16.2 and 53.6 percent. The 2.4 percent difference in average carbonate content between in-place and native sand is well within the acceptable limit of sampling error considering the highly variable nature of this measure.

Figure 2 presents grain size distribution curves for all in-place fill samples collected along the South Reach project. On average, between 11 and 19 percent of the in-place fill is coarser than 0.8 mm. This estimate corresponds very well to the pre-

project prediction of 17.5 percent (April 2001 permit modification request to FDEP). The sand placed during initial dredging, from SCS-II, contained a slightly higher percentage of coarse material and was generally better graded than that of CS-II.

The overall average median (d_{50}), coarse fraction (d_{84}), and fine fraction (d_{16}) grain sizes of the fill and native material are summarized in **Table 4**. The grain size of the in-place fill material matches the native berm material closely excepting the coarsest 20% to 25% of the SCS-II fill material. The fines content (<0.074 mm) of all of the samples is consistently low: less than 2.3% maximum, or <1% typical. The typical grain size of the in-place material along the landward edge of the fill is slightly finer than sand along the mid-berm location.

Table 4 – Grain size characteristics of South Reach Fill, SCS-II, and CS-II (mm)

		d_{84}	d_{50}	d_{16}
CS-II	R118.3-R121 Landward Berm	0.56	0.34	0.24
	R118.3-R121 Mid Berm	0.60	0.35	0.25
	R118.3-R121 All Berm	0.58	0.35	0.25
SCS-II	R122-R138.5 Landward Berm	0.78	0.35	0.23
	R122-R138.5 Mid Berm	1.34	0.38	0.24
	R122-R138.5 All Berm	1.04	0.36	0.23
	Native Beach - Berm	0.58	0.38	0.26
	Native Beach - MHW & Seaward	0.41	0.24	0.14
	Native Beach Overall	0.53	0.32	0.18
	SCS-II Core Composite	0.91	0.30	0.20
	CS-II Core Composite	0.70	0.36	0.23

Figures 3a through **3c** present a comparison of grain size distributions for the native sediments, the nourishment material, and both borrow areas. On the whole, the distribution of in-place fill appears compatible with that of the native berm material, particularly, in the percentage of sediments smaller than 0.5 mm in diameter (**Figure 3a**). The coarse fraction (>1 mm) of both borrow area composites and the in-place fill is, as predicted, 5 to 10 percent higher than the native berm material.

The data also indicate that the distribution of material larger than 0.6 mm in diameter remained nearly constant throughout the dredging and rehandling process

associated with initial construction (**Figures 3b** and **3c**). Some coarsening of the spoils was observed following placement, particularly in the initial construction phase. Distribution of the SCS-II core composite between 0.15 and 0.35 mm in diameter is finer than the range of collected in-place fill samples (**Figure 2**). An analogous reduction in fine-grained sediments was previously observed during construction of the Brevard County North Reach Nourishment Project, and the PAFB project both completed in April 2001. The North Reach project phase made use of similar dredge equipment and a nearshore disposal and sand rehandling area (NDSRA, see **Figure 1**). In monitoring the North Reach Project, sediments were sampled in the borrow area (CS-II), in-transit (on board hopper dredge), after rehandling by cutter-head dredge (in-place North Reach fill), and in-place via direct hopper dredge pump-out (Patrick AFB fill). The data suggest that some fine-grained sediments (0.15 – 0.25 mm) were lost during the hopper dredging of CS-II. These changes were identical for rehandled material and for direct hopper dredge pump-out, indicating that use of the rehandling area had little differential effect to the placed sediment.

In addition to the expected loss of fines within the in-place fill, the data also suggest a post-construction *fining* of the CS-II fill in the 0.3 - 0.8 mm range, on the order of about 0.1 mm (**Figure 3c**). The measured differences in this grain size range following placement likely represent geologic variations within the CS-II borrow area. The CS-II core composite was computed for the entire 1,200 acre borrow area limits and dredging for the second phase of the South Reach was confined to only a small portion of the borrow area. Considering the focused nature of CS-II dredging activities, it is surprising that the in-place grain size differences are not greater (in both magnitude and distribution), attesting to the relative homogeneous nature of the CS-II borrow site.

Figure 4 presents a stack plot, which charts the alongshore distribution of the percent in-place beach fill passing various sized sieves – the No. 10 (2 mm diameter), No. 18 sieve (1 mm diameter), and No. 50 (0.3 mm diameter) sieves are included in the plot. The data suggest the following:

- The percent passing a No. 10 sieve varied from approximately 83 to 100 percent. On average, approximately 6 percent of the total in-place fill is larger than 2 mm.
- Between 69 and 97 percent of the sampled in-place fill is finer than 1 mm. On average, approximately 15 percent of the nourishment is larger than 1 mm.
- The percent passing the No. 50 sieve ranged from 9 to 49 percent. The South Reach average percent passing the 0.3 mm sieve was 36.8 percent.
- The samples collected south of monument R-131 generally have a larger percentage of material retained when compared with those collected farther north.

The measurements of the in-place fill passing the 1 mm and 2 mm sieves were approximately evenly distributed about that of the borrow area composites, with the mid-berm sample being slightly more coarse than that collected on the landward berm (see **Figure 4**). The data indicate a larger difference between the mid-berm and landward berm samples in the southern portions of the South Reach, where sand was obtained from SCS-II. This disparity within the SCS-II material increases as the grain diameter fines and is readily apparent in the 0.3 mm plot.

The data in **Figure 4** additionally suggest that the in-place, CS-II fill passing the 0.3 mm sieve were similarly evenly distributed about that of the CS-II composite. The SCS-II borrow area composite appears to over-predict the percentage of material passed through the 0.3 mm sieve. That is, the in-place SCS-II material is generally more coarse than that computed for the borrow area composite, particularly through the medium to fine sand size range. Possible reasons for the difference between in-place and composite SCS-II sands are discussed below.

A frequency distribution of the composite samples associated with initial project construction is presented in **Figure 5**. The frequency data demonstrate the bi-modal nature of the initial, SCS-II in-place fill -- with peak frequencies centered about 0.25 mm (primary) and 0.85 mm (secondary). Most notably, the data indicate an approximate 7.7 percent post-construction increase in the percentage of sediments retained in the 0.85 mm diameter range. The SCS-II composite predicted an average post-construction increase in

the frequency of the 0.85 mm bin to be on the order of 4.5 percent (**Figure 7**). The difference between the predicted and post-construction increase in the bi-modal disposition of the fill is due to an underestimation of coarse surface sediments immediately adjacent to the permitted borrow area limits.

Specifically, in revising the SCS-II borrow area limits and composite profile, sub-bottom seismic data were utilized to estimate and include the influence of coarse material identified in cores taken outside of the SCS-II permitted boundary. Inclusion of grain size data from cores collected immediately outside of the permitted borrow area was primarily intended to compensate for unforeseen inconsistencies within the geologic strata, but did not attempt to consider direct dredging of these sediments. Contractor observations during excavation of SCS-II, however, suggest that dredging near the permitted borrow area limits probably induced slope adjustment of the adjacent seabed into the borrow area limits. This material was subsequently dredged from within the permitted limits and utilized for construction of the South Reach. This activity resulted in both a greater than anticipated gross sediment yield -- as well as the inclusion of coarser material from the seabed surface immediately surrounding the borrow area.

Figure 6 presents the distribution of sediment grain sizes for the sands utilized in construction of the second phase of South Reach construction. The sand dredged from CS-II was better sorted than that of SCS-II and does not exhibit the bi-modal distribution of the initial nourishment. Overall, sand from the CS-II borrow appears to be as coarse or slightly coarser than the native beach as compared with native MWL samples.

Figure 8 compares the grain size distributions of the average, in-place North Reach and South Reach beach fill projects. Both the North Reach and second construction phase of the South Reach fills utilized material dredged from the CS-II borrow area. Sand dredged for the North Reach was deposited in the nearshore and pumped onto the beach via cutter head dredge, whereas the second phase of South Reach construction was completed by hopper dredge pump-out. As expected, the North Reach and South Reach (2003) distributions are very similar. The South Reach material from

CS-II appears slightly finer-grained than the North Reach material. The difference is small, but otherwise unexplained except that different portions of the CS-II borrow area were used for each project.

Overall, the distribution of sediments finer than about 0.5 mm (70 percent passing) is very similar for both projects. The most significant difference between the grain size distribution of sand within each borrow site appears to be in the range of the 1 mm sieve. The average percent of the North Reach/2003 South Reach (CS-II) and initial South Reach (SCS-II) projects finer than 1 mm is about 91 and 86 percent, respectively. The increased frequency of material retained in the 1 mm sieve is responsible for the stronger bi-modal nature of the initial South Reach fill. It is also noted that beyond the 5% difference in coarse fraction, the CS-II coarse shell fraction is smoother (better rounded) than that of the SCS-II material.

Summary

Approximately 1.4 Mcy of beach quality sediments were excavated from the SCS-II borrow area and placed into the SNDSRA for subsequent rehandling onto the southern 15,500 feet of the South Reach project area in 2002. The northern 4,500 feet of the South Reach project was completed in 2003 by the direct hopper dredge pump-out of approximately 325,000 cy of sand excavated from the CS-II borrow area. To date, SCS-II is fully developed (depleted) while approximately 23.2 Mcy of sand remain within the permitted limits of CS-II.

Overall, the in-place material is slightly coarser than that of the SCS-II borrow area composite primarily due to either the anticipated loss of fines associated with hopper dredging and the possible excavation of reposed sands surrounding the borrow area. There was little variation between the CS-II borrow area composite and the in-place fill. Small variations exist and are due to geologic variations within the CS-II borrow area which are observable due to the limited extent of South Reach dredging in CS-II.

There are no significant alongshore differences in the grain size composition of the placed material, excepting a weak indication of higher fractions of bulk coarse material (>1mm) south of R-131. The landward berm material is slightly finer than the mid-berm material, on average, but this may be due to expected sampling variations. The northernmost end of the initial, 2002 construction berm may include some material dredged from Canaveral Shoals II; however, this represented a small fraction of the fill material (<50,000 cy). The grain size distributions of the SCS-II and CS-II fill material are very similar, except that the SCS-II material has approximately 5% greater coarse fraction at the 1.0 mm size.

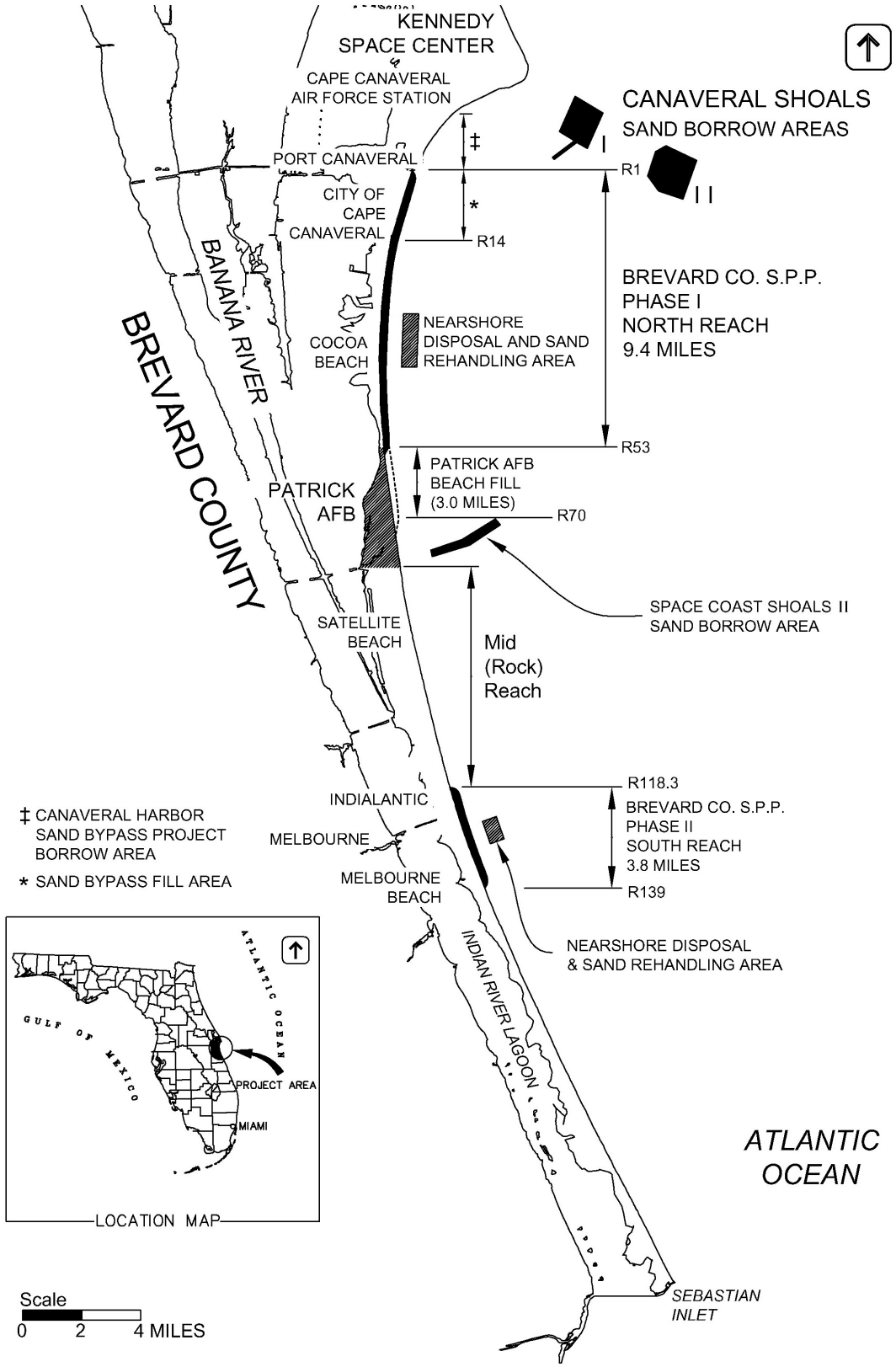

Figure 1 – Brevard County Shore Protection Project location map.

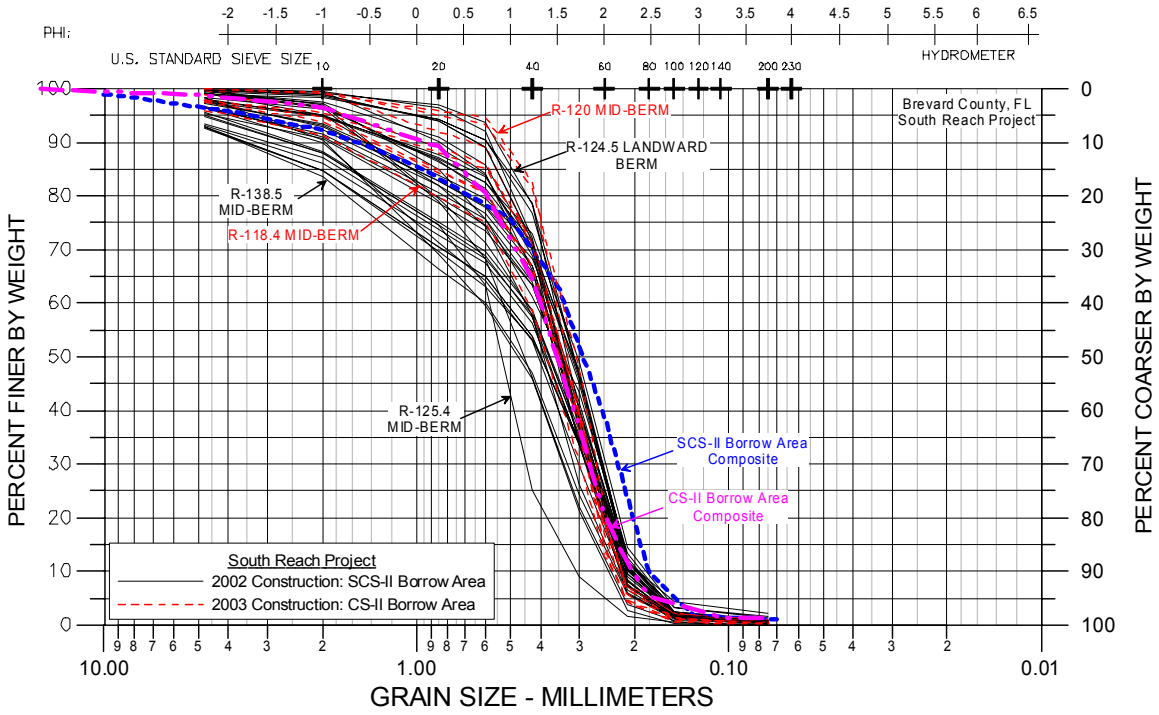

Figure 2 – Grain size distribution of all in-place fill samples. The core composites of the SCS-II and CS-II borrow areas are included for reference.

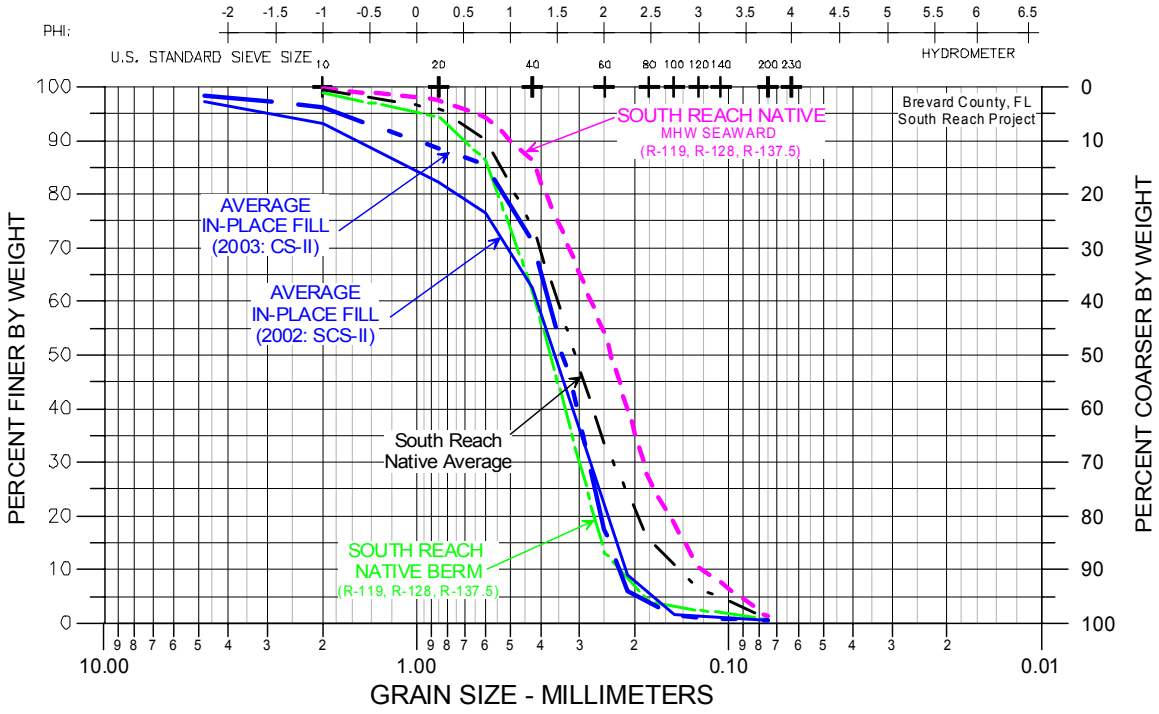

Figure 3a – Summary of grain size distribution curves including both construction intervals of the South Reach fill and native beach samples.

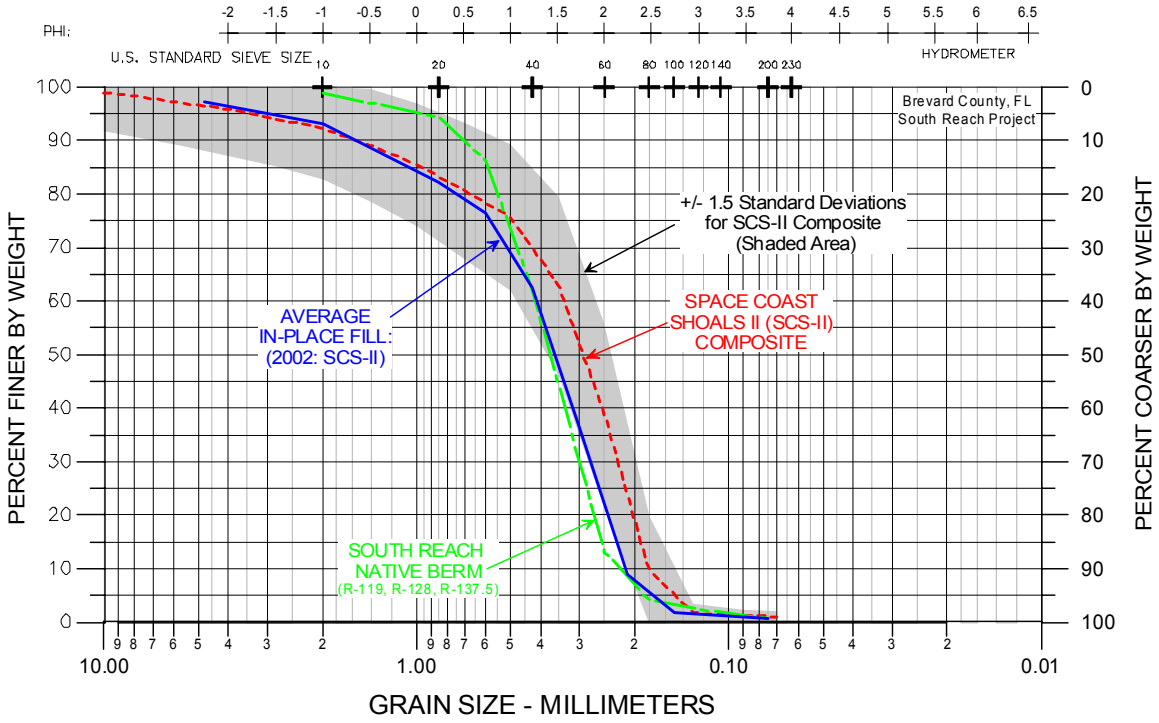

Figure 3b – Summary of grain size distribution curves including both construction intervals of the South Reach fill, native berm, and the SCS-II composite.

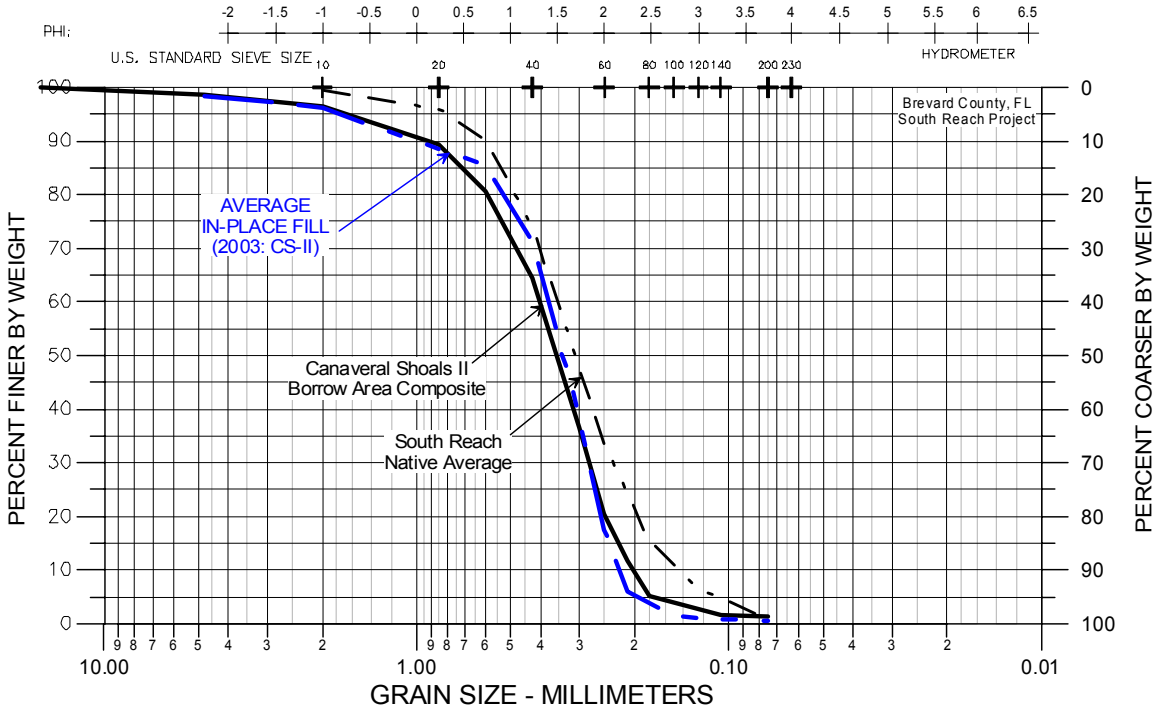

Figure 3c – Summary of grain size distribution curves including both construction intervals of the South Reach fill, native average, and the CS-II composite.

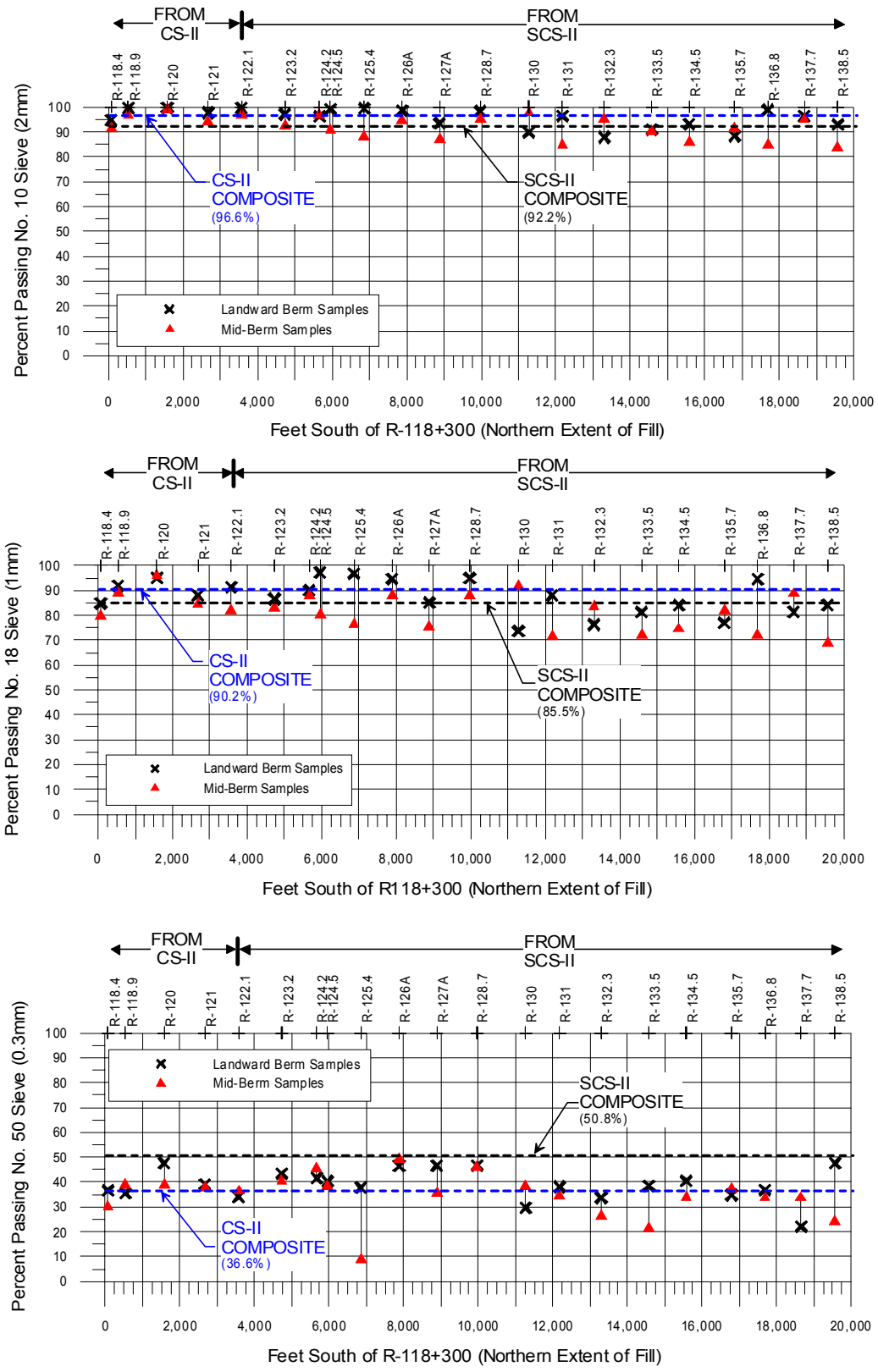

Figure 4 – Alongshore distribution of in-place beach fill material passing the No. 10 sieve (2 mm), No. 18 Sieve (1 mm), and the No. 50 sieve (0.3 mm).

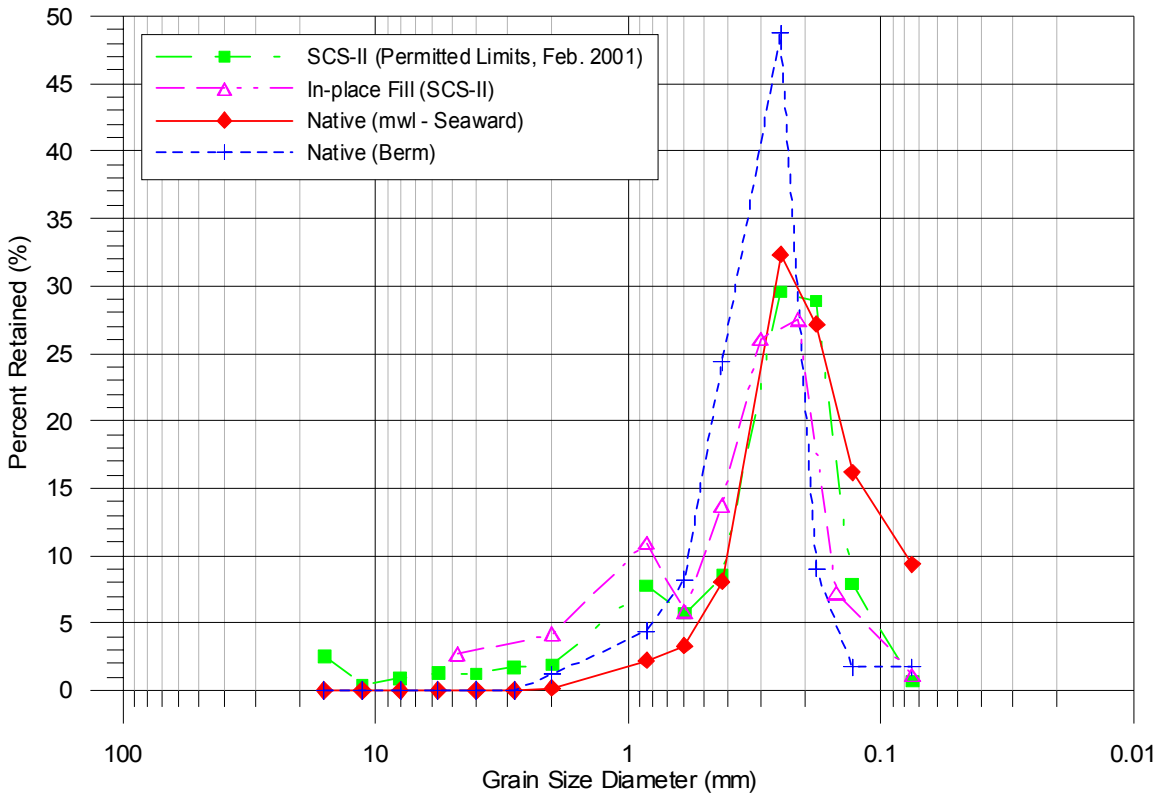

Figure 5 – Frequency distribution for native, borrow, and fill sediments constructed from Space Coast Shoals II sand borrow area along the initial phase (southern 15,500 feet) of the Brevard County Shore Protection Project, South Reach.

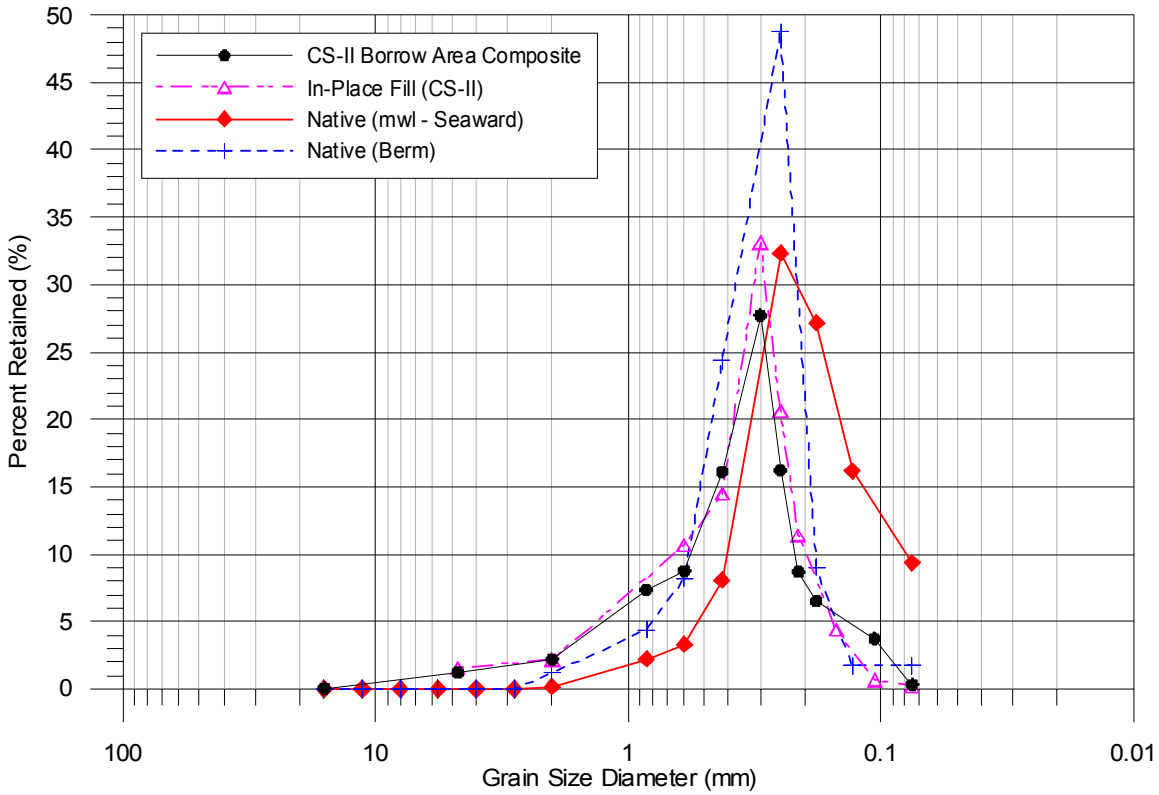

Figure 6 – Frequency distribution for native, borrow, and fill sediments constructed from Canaveral Shoals II sand borrow area along the secondary phase (northern 4,500 feet) of the Brevard County Shore Protection Project, South Reach.

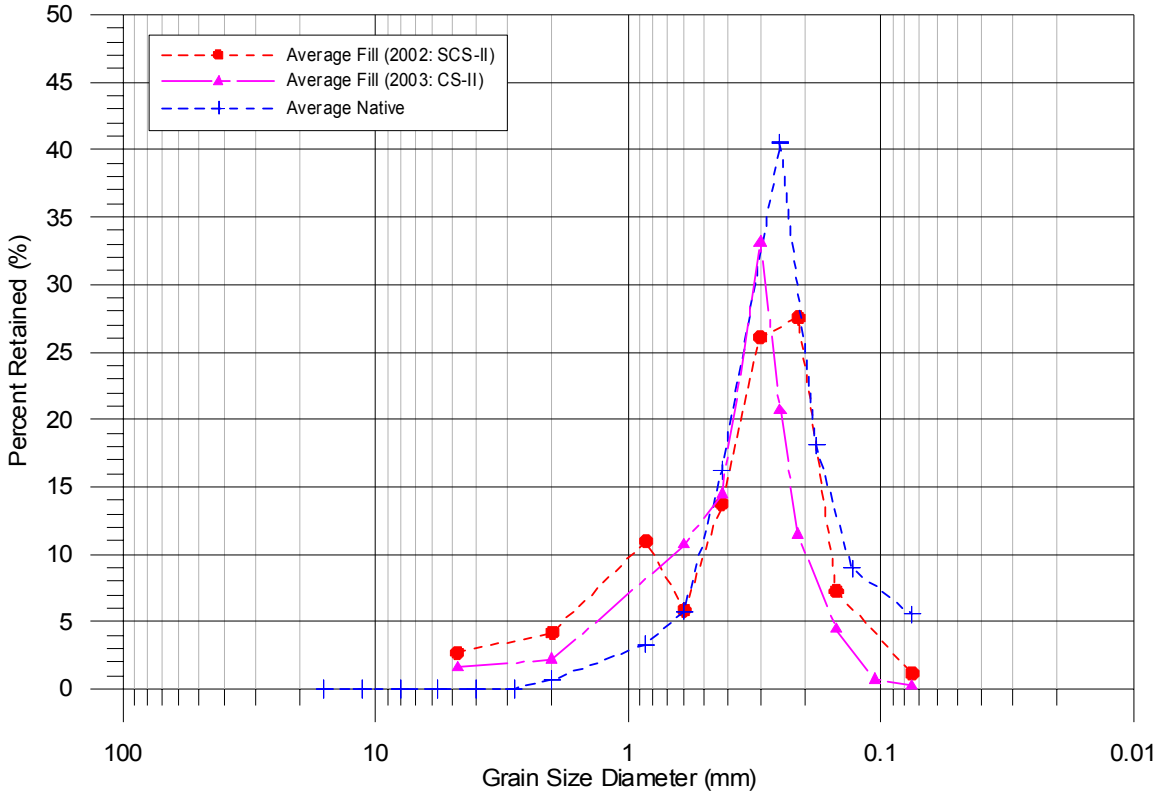

Figure 7 – Average frequency distribution for native and fill sediments constructed along the Brevard County Shore Protection Project, South Reach.

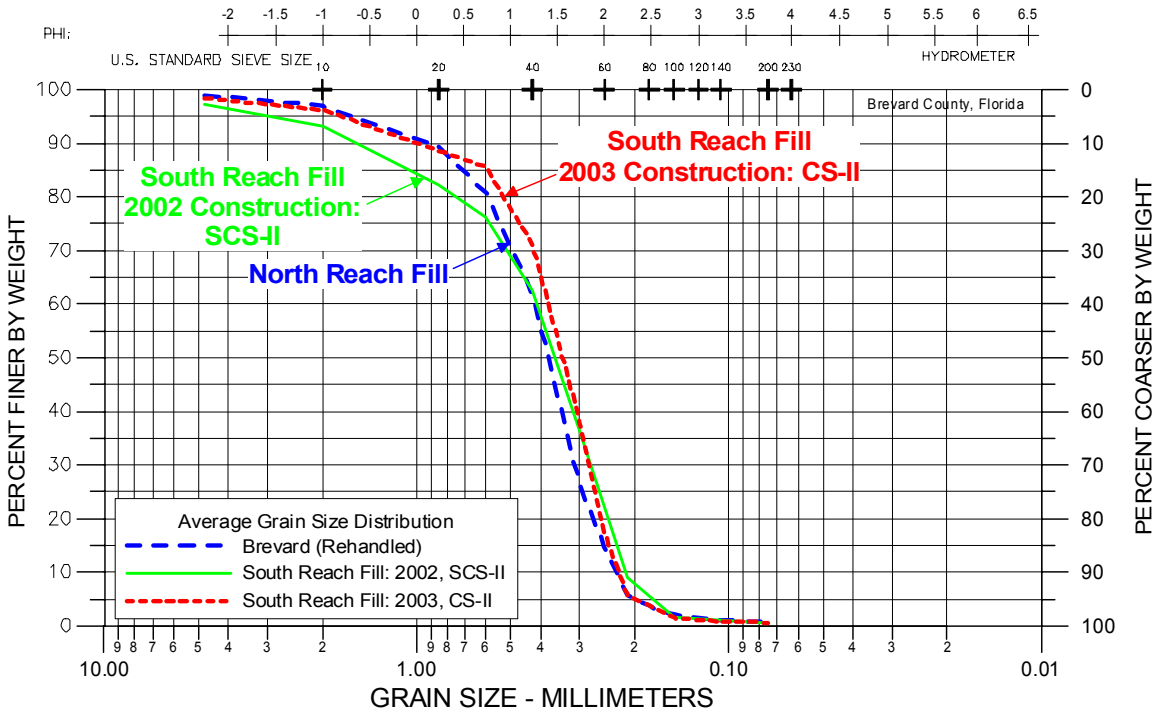

Figure 8 – Comparison of the North and South Reach in-place beach fills.